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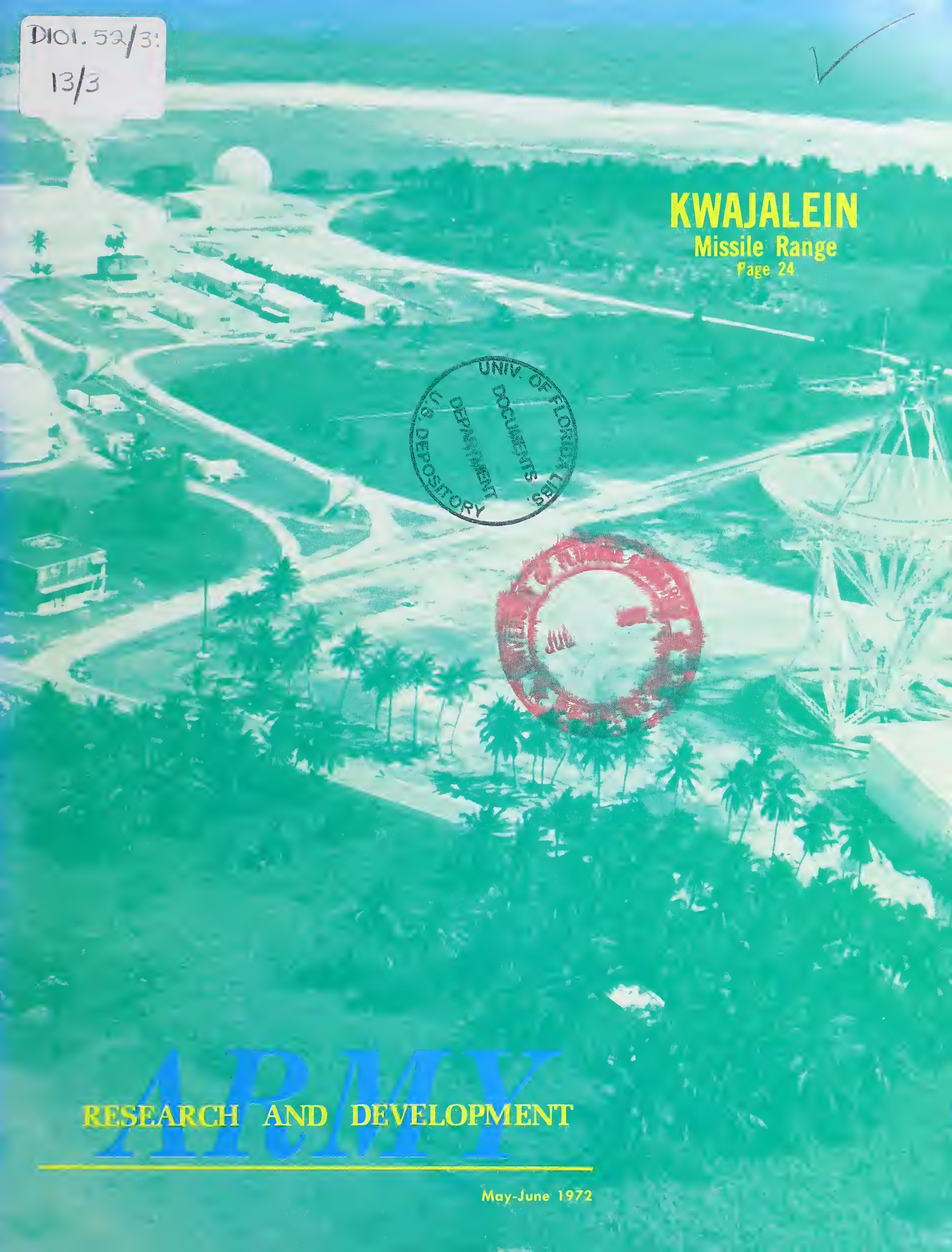

KWAJALEIN
Missile Range
Page 24

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ARMY RESEARCH AND DEVELOPMENT

May-June 1972

SPEAKING ON . . .

The Metric System in World Trade

Dr. Lewis M. Branscomb

Federal government support for U.S. conversion to the metric system of measurement is on the increase, as evidenced by recent U.S. Department of Commerce activities.

Secretary of Commerce Peter G. Peterson has sent to Congress proposed legislation that would create a National Metric Conversion Board. Its purpose would be to plan and coordinate a voluntary conversion process in which metric units like the meter, liter and kilogram would become basic units of measurement—replacing the yard, quart and pound units.

Comprised of 25 representatives of industry, trade associations, citizens groups and government, the board would assist in public adjustment to the system.

Former Secretary of Commerce Maurice H. Stans and Dr. Lewis M. Branscomb, director of the National Bureau of Standards, are among U.S. leaders who are urging conversion to the metric system.

Speaking recently on "The Metric System in World Trade" at the Export Marketing Symposium at Denver, Colo., Dr. Branscomb stressed that industries which rely heavily on science and technology profit most by international trade. He pointed out that most nations dependent on world trade, via new or improved products resulting from research and development, have already converted to the metric system.

From 1963 to 1967, he said, U.S. industrial R&D grew at a rate of 6.7 percent, while in Germany, Japan, France and Canada R&D investment was growing at rates between 16 and 21 percent.

Because Dr. Branscomb's address is considered of particular interest to the R&D community, in that it strongly stresses the role of R&D in the national economy and in world trade, it is published here almost in its entirety.

* * *

"One reason for my support [of the metric system] is my great concern over America's position in world trade. We are now facing an important international challenge of competition in the world marketplace, a challenge symbolized by a net deficit in the balance of trade for the first time this century.

"Since 1960, U.S. manufacturing productivity has risen 32 percent. But Japanese productivity has almost tripled in the same period. Over the past decade U.S. exports of manufactured goods rose 110 percent—a respectable performance. Japanese exports quadrupled.

"We are being challenged at the game we know best: organizing for innovation and accomplishment at the technological frontier, as Dr. Edward David, the President's Science Adviser, has put it.

"Over-all, U.S. industry performs and uses its R&D better than any nation in the world. And those industries that rely most heavily on science and technology do best in international trade.

"The challenge is to build on this base of technological strength and innovative spirit to strengthen the vigor of our total economic activity.

"A favorable balance of payments is only one of the performance characteristics for a healthy economy. Our rate of productivity has also been falling, on the average, over the whole of the last century. A rising living standard with controlled inflation must rest on raising our productivity."

"New demands are being placed on our economy by the pursuit of an improving quality of life for our citizens. The President's Council on Environmental Quality has predicted that control of all environmental pollution would require additional investments of $105 billion over the next five years. And with 60 percent of the labor force now engaged in the service sector of the economy—where productivity rose only 0.4 percent per year during 1966–1970—it is clear that *manufacturing alone cannot carry the responsibility for over-all productivity improvement.* (Italics added.)

"For 1971, Secretary of Commerce Peter G. Peterson (when he was Assistant to the President for International Economic Affairs) projected growing trade deficits in minerals and raw materials ($3.3 billion), a favorable balance in agricultural products ($2.5 billion), and a deficit of ($0.7 billion) in manufactured goods.

"Among 'nontechnology-intensive' manufactured products, such as shoes, furniture and garments, the deficit is growing very rapidly. Among high-technology products, where we enjoy a favorable balance of $8.4 billion, we are more nearly holding our own. Yet, between 1955 and 1967 the U.S. share of world trade in such products fell by 10.7 percent, almost all of which was taken up by Japan and Germany. After a number of years helping Japan and Germany to rebuild democratic societies from the ashes of World War II, the U.S. is in 'a whole new ballgame.'

"As a nation, we should welcome this challenge to our competitiveness. Imitation, after all, is the sincerest form of flattery. More important, the impressive performance of our friends abroad serves to remind us that the ability to put science and technology to work for the benefit of the nation as a whole is not unique to our society; technical knowledge has universal value for mankind. Competitive commercial enterprise is the most effective social organization for meeting the public's needs for goods and service.

"Our obligation, then, is to look to our most valuable assets and make sure that Americans are encouraged to do even better at that which we do best.

"Many indicators suggest that in recent years we may not have nurtured our science or harnessed our technology as well as we might. Even before our R&D community had to adapt to the shifting of our economy from a wartime to peacetime focus, the rate of growth of private industry research investments were lagging the competition abroad. . . .

"There can be no doubt that America's investments in science have produced extraordinary advances in basic knowledge. And our advances in the fields of special interest to the federal government—defense, atomic energy and space—have been enormous.

"The new technology and the new products which have been developed from our investments in those fields have put us out front on the world market. This includes the high-technology areas of computers and information systems, as well as complex instrumentation, electronics and materials.

"Even in these fields, however, we are being beaten at our own

(Continued on page 46)

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ARMY RESEARCH AND DEVELOPMENT

Vol. 13, No. 3 May-June 1972

ABOUT THE COVER . . .

Kwajalein Missile Range, one of the vital testing centers for Department of Defense missile systems, including the Safeguard Ballistic Missile Defense System, is shown in an aerial photograph. Located on Kwajalein Atoll, it is one of five U.S. national test ranges. The atoll is composed of about 100 small islands with a total land area of 5.6 square miles, and the U.S. Government has land-use agreements for 15 of these islands on which the range conducts its activities. The back cover shows telemetry and high-frequency radio facilities on neighboring Ennylabegan Island.

Editor . . . . **Clarence T. Smith**
Associate Editor . **George J. Makuta**
Associate Editor . . . **Philip A. Farris**

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FEATURES

OSDOC II Joint Exercise 4
Foreign Science and Technology 6
Nixon Proposes United R&D Effort 12
RAM Stressed as Priority Effort—MG John R. Guthrie 14
Nonmetallic Cartridge Cases 17
Technology Leads to Conflict of Interests—Dr. R. J. Heaston 20
Pesticide Residues in Utah's Waters—P. R. Johnson 21
Aircraft Materials Research—A. P. Levill and E. Dicesare 22
Kwajalein Missile Range—MAJ D. R. Gramley and R. I. Eison 24
MERDC Demonstrates Integrated Transistor Switch—E. Reimers 27
Technology Assessment—Harold Davidson 28
Thermal Fingerprint Betrays Materials Defects—Paul E. Vogel 31

DEPARTMENTS

Selective Scanner 2
R&D News 8
In Retrospect 18
Career Programs 32
Conferences & Symposia 36
Personnel Actions 38
Awards 40
Contracts 42
Reader's Guide 45

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Selective Scanner . . .

FDA Joins With EPA in New Center at Pine Bluff

Conversion of multi-million dollar laboratory facilities and 500 acres of the 15,000-acre Pine Bluff (Ark.) Arsenal to a National Center for Toxicological Research was started in May as a joint venture of the U.S. Food and Drug Administration and the Environmental Protection Agency.

Formerly one of the U.S. Army's two major centers for biological warfare, along with Fort Detrick, Md., Pine Bluff Arsenal has now completed destruction of its stocks of biological agents and weapons. Arsenal Commander COL Sampson H. Bass said the destruction and sterilization program was accomplished at a cost of about $12 million.

President Nixon called for termination of biological warfare Nov. 25, 1969, in a message that appealed for worldwide support, and committed the United States to destroy its capability. An international agreement taking this action was signed Apr. 10, 1972, involving approximately 80 nations.

About 100 Pine Bluff scientists will be transferred to the National Center for Toxicological Research. Another 90 employes will continue to provide maintenance and operations support for which the new agency will reimburse the Army.

No reductions in force are contemplated as a result of the revision of the Pine Bluff Arsenal operations, COL Bass stated. The current staff of about 1,400 will be reduced to 1,292 but reassignments and normal attrition will absorb this cutback.

Except for abolition of its biological agent capability, Pine Bluff will continue to perform its other functions in production of screen and signal smokes, white phosphorous, riot control agents and development operations. The arsenal depot will continue its mission of storing chemical agents and munitions.

A new Directorate of Engineering and Technology was established recently to improve munitions of this type and to produce them more economically.

Fort Detrick Transferred from AMC to OTSG

Another phase in the conversion of Fort Detrick, Md., to research for the welfare of mankind, after long being known as the U.S. Army's major center for biological warfare research, began April 1. A National Cancer Institute research facility was established there last October, with President Nixon present to speak on the new role of the installation.

The Army Surgeon General announced that the transfer of Fort Detrick from the jurisdiction of the commanding general, U.S. Army Materiel Command, to OTSG was effective in April. Responsibility for operation and administration of the installation has been assigned to the Medical R&D Command.

Four medical units will move to Fort Detrick this year to join with the present tenants which, in addition to Department of Defense activities, include the National Cancer Institute element and facilities operated by the Department of Agriculture.

The medical units that will move were not identified.

Army Vets Aid in Poultry Epidemic Control

Twenty Army veterinary officers were rushed to the West Coast in mid-April to assist in stifling an epidemic of exotic Newcastle disease destroying the chicken population in eight California counties.

Sometimes called avian pneumoencephalitis, the disease affects chickens and other fowl in much the same way as pneumonia affects humans. It is particularly deadly for young chicks, sometimes reaching 90 percent fatality.

The disease can affect the central nervous system and sometimes progresses into encephalitis. It begins with an upper respiratory infection, manifesting itself in chicks by coughing and sneezing.

Asked by the U.S. Department of Agriculture to help, the Army veterinarians assisted in inoculating poultry in the infected area, and also assisted in the systematic inspection and disposal of infected and exposed flocks.

Army Resumes Scientific Services Program

Resumption of the Army Scientific Services Program, which provides for assistance in the solution of fundamental problems of national importance, critical to the performance of various missions, is assured by a new contract awarded Apr. 17.

Generally, this contract provides for the use of highly qualified scientists, engineers and technicians by furnishing required facilities, by establishing working conferences and study groups, and by the initiation, organization and management of seminars, symposia and similar scientific and technical forums.

The Army Research Office-Durham, N.C., which has long administered the program, will continue this function under the new contract awarded to Battelle Columbus (Ohio) Laboratories in the amount of $156,510.

The Army Scientific Services Program has been suspended since Duke University, Durham, N.C., terminated its contract in the fall of 1971.

DoD Task Group Offers In-House Lab Proposals

A 6-month study of Department of Defense (DoD) in-house laboratories by a special Task Group has resulted in a number of recommendations for change that affect all the Services.

Established by the Deputy Secretary of Defense and the Director of Defense Research and Engineering on Feb. 4, 1971, this 7-man group was one of three task groups formed. The other two were concerned with Defense test and evaluation activities and Federal Contract Research Centers.

The objective of the Task Group on In-House Laboratories was defined by then Deputy Secretary of Defense David Packard as follows:

". . . to identify what actions should be taken, if any, as recommended by the Blue Ribbon Defense Panel. For those actions necessary, you should develop a time phased plan for improving the overall quality and effectiveness for our RDT&E base including a determination of the essentiality of the various components of this base."

Not all of the 28 recommendations emanating from this study apply to the Army. Those that do are being addressed by the Department of the Army and the Army Materiel Command under an "Army Implementation Program."

A number of the actions called for by this Program are already accomplished or on-going. Others are under review. *(A long article on the study will be in the July edition.)*

New Training Approach Developed for MVA

Developed as part of the broad plan for conversion to a Modern Volunteer Army is a new approach to recruit training originated by scientists of the Human Resources Research Organization (HumRRO) and Army trainers at Fort Ord, Calif.

The "Experimental Volunteer Army Training Program" (EVATP) is a totally integrated system based on six established learning principles, namely: Performance-oriented instruction; learning in a functional context; self-pacing of instruction; insistence on mastery; feedback to instructors and trainees; and quality control.

Course objectives and performance tests in the 16-week EVATP were determined jointly by Fort Ord and HumRRO, and were validated by the U.S. Army Infantry School as improving the level of proficiency, and attenuating achievement differences attributable to aptitude level.

The U.S. Continental Army Command (CONARC) has directed that training courses in all Army Training Centers be revised to incorporate the principles used in EVATP. HumRRO teams are visiting 14 Army training centers and schools to assist in implementing these concepts.

Froehlke Accepts Army Science Conference Bid

Secretary of the Army Robert F. Froehlke will present the banquet address at the U.S. Army Science Conference, June 21–23, at the U.S. Military Academy, West Point, N.Y.

Expected to attract 450 or more of the leading scientists in the Army, Department of Defense and top-ranking officials of the defense research and development establishments in the United Kingdom, Canada, Australia, France and Germany (the latter two nations for the first time), the conference will feature a panel discussion.

Jack I. Hope, technical assistant to the Director of the Office of Science and Technology, Executive Office of the President, has accepted an invitation to preside as chairman of the panel. The theme will be "Reliability, Availability and Maintainability" (see feature article on RAM objectives on page 14).

Panel members are: MG Curtis Chapman, Deputy CG, U.S. Army Combat Developments Command; Dr. Martin Shooman, Department of Electrical Engineering, Polytechnic Institute of Brooklyn, N.Y., who will represent the academic community;

S. J. Miller, manager of Reliability and Quality Assurance, General Electronic Co. Aerospace Electronic Systems, who will represent the electrical and electronics industries; Charles W. Ellis, chief engineer, Boeing Vertol Division, who will represent the aerospace industry; Thomas E. Bottle, chief engineer for engines, International Harvester Co., who will represent the automotive industry; and LTG Woodrow W. Vaughan, Deputy CG U.S. Army Materiel Command.

One hundred technical papers listing the names of an all-time record 257 authors or coauthors are programed.

Generator Kits Ease Maintenance

Thermal and acoustic kits for Military Standard gasoline engine-driven generator sets, in the 0.5 to 10 kw range, have been developed by the U.S. Army Mobility Equipment Research and Development Center.

Acoustically treated housings are tailored to each generator set. They also provide thermostatically controlled cooling when sets are operated in confined locations (bunkers, revetments, etc.), thereby easing the related problems of excessive maintenance and limited life that were reported in Southeast Asia.

The thermostatic control also functions to insure that proper engine operating temperatures are maintained in extremely cold climates. Standard generator sets have essentially no controls for engine operating temperatures, which tend to run high in hot climates and subnormal in cold.

Noise reduction can be increased by addition of sand bags or other material around the engine housing, thereby providing protection from hostile action.

2 Firms Studying Aircraft Vulnerability

Contracts totaling $798,000 represent a dual research effort launched recently by the Army Air Mobility R&D Laboratory, Fort Eustis, Va., to develop better protection from enemy ground fire for light reconnaissance aircraft.

Labeled "Armored Aerial Reconnaissance System (AARS) Vulnerability Study," the research will focus on the study and assessment of various conceptual investigations aimed at reducing to a minimum the vulnerability of AARS aircraft in combat.

Vertol Division of the Boeing Co., and Lockheed-California Co. under contracts for $448,000 and $350,000, respectively, will conduct the research in two phases.

Data will be gathered and preliminary design studies made of various approaches to the problem. In the second phase, designs of selected approaches will be refined and a risk assessment established.

National R&D 'Real' Spending Drops

Since 1964 the United States has been investing an ever smaller share of its resources in research and development.

During the last five years the real growth of R&D spending, after compensating for inflation, has been 3/10 of 1 percent a year, down from an average real rise of 11 percent in the late 1950s and 7 percent in the early 1960s.

According to Dr. Murray L. Weidenbaum, Assistant Secretary of the Treasury for Economic Policy, the slow-down in R&D spending seems even more substantial without the inflationary compensation.

Before taking out the inflationary dollar increase the average growth rate, he said, looks like this: an average rise of nearly 14 percent a year in the late 1950s, down to 9 percent in the early 1960s, and to less than 5 percent in the late 1960s.

(Editor's Note: R&D spending may be increased significantly in view of the President's special message to Congress on March 16. See article on page 12.)

Computer Systems Command Increases SAMAC

Thirteen new members were added to the U.S. Army Computer Systems Command Scientific and Management Committee (SAMAC) during its recent meeting at Fort Belvoir, Va.

SAMAC is made up of nationally prominent data systems scientists and authorities from universities and private industry. Twelve members serve as the primary working group, assisted by 20 consultants employed at the direction of the USACSC.

The committee's function is to advise, review technical and management topics, and make recommendations to the commanding general in varied facets of data systems. These are associated with the execution of his responsibilities as project manager for multi-command data systems of the U.S. Army, including the technologies and trends pertinent to the long-range goals of the command.

Committee chairman is Dr. Vincent P. Luchsinger, College of Business Administration at Texas Tech University.

MILVAN Ammunition Conveyor Tested

Conveyorizing of cargo in and out of Army MILVAN containers to simplify airlift is under investigation by the U.S. Army Mobility Equipment R&D Center. Fort Belvoir, Va.

The existing U.S. Air Force 463L detachable roller conveyor system, scheduled for Army Materiel Command testing, has been adopted by the center for the 8 × 8 × 20 foot container. It is part of a feasibility study of containerization as a means of shipping cargo from the U.S. to oversea theaters and forward supply points.

The container conveyor system has been designed for compatibility with the Air Force material handling system to permit rapid loading and unloading of cargoes packed on Air Force 463L pallets. This interface is expected to eliminate the break bulk repacking of cargo now necessary at air head terminals.

AVSCOM Establishes Cobra Systems Office

The U.S. Army Aviation Systems Command (AVSCOM), St. Louis, Mo., recently established a product manager's office for AH-1 Cobra aircraft systems, under the Army Materiel Command.

The office has primary responsibility for management of the Improved Cobra Armament Program as well as all other Cobras in the field.

Under a $24,732,793 prime systems integrator contract awarded by AVSCOM, Textron's Bell Helicopter Co. will engineer and develop an improved armament system.

The new TOW (Tube-launched, Optically-tracked, Wire-guided) missile system will be used as a modification of the AH-1G HueyCobra, and will give it a new capability—that of destroying tanks from the air.

OSDOC II Joint Exercise . . .

Techniques for off-shore discharge from containership will be tested in important containerization program

Full-scale containerization of Army cargo, expected in the years ahead to link up with the growing fleet of containerships, will be given a boost toward reality in OSDOC II (Off-Shore Discharge of Containership) tests in September or October.

A joint Army/Navy exercise at Fort Story, Va., OSDOC II will examine equipment and procedures for discharging containers from containerships, and moving them across beaches in logistics over-the-shore (LOTS) operations. Results will help the Army define a system applicable to the short-range future (1973–77) by determining what facilities are needed in an over-the-shore environment and how these should be further developed.

Lessons learned in the first OSDOC, held Dec. 5–9, 1970 at Fort Story, will be applied to techniques and systems using both air and surface lighters, with emphasis on the latter. Both military and commercial equipment is expected to be used during the exercise, which will run for 5 days and involve approximately 700 Army troops.

Among Army units participating will be a terminal service company, 2 medium truck platoons, transportation boat units, helicopter crews and associated personnel.

OSDOC II is concerned primarily with surface equipment since present-day helicopters, which were used effectively during OSDOC I, have limited lifting capabilities. Helicopters capable of lifting fully loaded sea-van containers (20- to 25-ton class) are not expected to be ready for use in the near future.

Systems and equipment being tested will be separated into two broad categories, the first consisting of equipment and methods which can be tested and evaluated independently of the containership or other high-cost test support items. Category II equipment and methods or systems are those which cannot be tested independently of the containership or the ship's discharge cranes.

OSDOC II will extend through three phases. Phase I will be a preliminary evaluation of equipment and systems to determine their relative potential in an off-shore discharge role.

This evaluation will be carried out by a Joint Panel (Army/Navy) consisting of personnel experienced in LOTS operations and engineering. The panel will rely on Department of Defense in-house resources and no-cost assistance from commercial developers to conduct its work.

CH-54 helicopter lifts MILVAN container from ship's hold in process of transporting it to beach for unloading on trailer bed.

Phase II will consist of independent tests and operational evaluations of equipment and methods identified as Category I during Phase I. The duration of this phase will be governed by the items identified.

Phase III, to be initiated as soon as the containership arrives at the Fort Story test site, will consist of testing and evaluating equipment and methods identified as Category II during Phases I and II.

Phase III tests, emphasizing the evaluation of total systems, including equipment, will last from 5 to 7 days.

The Army has set 11 objectives it hopes to meet during the tests. They are, to evaluate:

- Surface systems for discharging containers from offshore self-sustaining and/or non-self-sustaining containerships.
- Selected items of currently available lighterage in the role of container lighter.
- Currently available materials handling equipment in transferring loaded containers from lighters to shoreside conveyances.
- Platform deck concept of stowing and discharging noncon-

LCU standard lighter vessel heads for shore with MILVAN containers unloaded from the containership shown in the background.

LARC XV, used extensively during OSDOC I, will again see considerable service in this year's exercise at Fort Story, Va.

tainerized equipment in containership holds and on deck.

- Container hookup and lifting devices in containership off-loading operations.
- Tasks and personnel performance for containership deck crew cargo and line handling functions.
- Effects of sea state, current, surf, relative motion, beach gradient, and beach conditions during discharge operations.
- Selected vehicles and equipment for container transport and handling.
- Effectiveness of command, control, and communications operations.
- Explosive embedment anchor for use in mooring the containership offshore.
- Determine safety procedures during evaluation of all other objectives.

In consideration of a U.S. Merchant fleet consisting increasingly of containerships, OSDOC II is an especially important exercise. The Army, as well as the other Services, must rely heavily on these ships to deploy and support military forces.

Containerization methods and the use of containerships have much to offer the Military Services. This technology can mean less time in port, less pipeline time (that is, in transit from suppliers to users), and considerable savings in money when shipment of supplies and ammunition is made using containers.

COL Raymond A. Cramer, project manager for the Department of Defense (DoD) surface container systems and joint test coordinator for OSDOC II, stated that "If all Vietnam ammunition shipments could have been containerized, we would have realized pipeline and other savings in excess of $100 million."

One major problem to be confronted during OSDOC II is that of getting containers off of non-self-sustaining containerships, which are vessels that do not have their own gantry cranes for off-loading.

Since most of the merchant ships now in service are non-self-sustaining, one of the first objectives during the exercise will be to examine several candidate items of equipment and procedures for vessel discharge.

One is a mobile crane that will be tested aboard ships, lifting and moving containers to a central lift area and over the side. Another is a standard 100-ton floating crane. A third item will be a large mobile crane mounted on a floating DeLong pier alongside the ship. A fourth will be a self-sustaining ship discharging the non-self-sustaining ship.

An integral part of the total containerization program is the examination of materials handling equipment (MHE) being done by AMC's Mobility Equipment Research and Development Center (MERDC) at Fort Belvoir, Va., an agency of the Mobility Equipment Command (MECOM), headquartered in St. Louis.

MERDC is currently evaluating the Caterpillar frontloader and the Allis-Chalmers sideloader. These studies are part of the preliminary evaluations required for OSDOC II, since MERDC is responsible for much of the "hardware" to be used in the exercise.

Container transport vehicles that will be tested by the Army during the beach operations of OSDOC II include the rear self-loader/unloader, developed by the Tank-Automotive Command (TACOM), Warren, Mich., and a modified M-127 S&P (stake and platform) trailer. The Navy and Marine Corps will also test some of their own transports.

Each major Army command has key responsibilities in OSDOC II. CONARC, while providing the U.S. Army test director and staff, also:

- Prepares the implementing Army test plan and assists the joint test director in coordinating it with the plans of other Services.
- Implements the Joint Test Plan for OSDOC II, to include necessary independent field evaluation of equipment.
- Provides training and operational sites, medium and heavy-lift helicopters, and necessary administrative support.

CONARC also prepares the U.S. Army after-action test report and forwards it to the joint test director.

AMC provides the joint test director, acts as over-all coordinator for all aspects of the evaluations, and:

- Lists Army Research and Development (R&D) items of equipment to be

(Continued on page 30)

U.S. ARMY SPECIAL EQUIPMENT (OSDOC II)

FROM CONARC

Type	*Quantity*
M-52 tractor	40
M-127 S&P trailer	20
Tugs, 65-foot	3
LCU	6
LARC-15	2
LARC-60	1
LCM-8	4
BC barges	2
CH-54 helicopter	2
CH-47 helicopter	2
Tractor, D-7	2
UH-1B helicopter	2
Sedan	6
PSP/MOMAT	1 acre (est)

FROM AMC

Type	*Quantity*
MILVAN Containers	120
MILVAN Chassis	30
250-ton mobile crane	1
100-ton mobile crane	1
DeLong piers	2
Container MHE (front loader)	1
Rear self-loader/unloader trailer	1
Lightweight spreader bar/lifter	1
Container lifters (commercial)	5
N-127 S&P trailer (modified)	1
BC barge	1
Explosive embedment anchors	4 (est)
Acoustic underwater survey equipment	1
Seatrain class ship (to be chartered by MSC)	1
Aircraft cargo loading and unloading tracked truck	6

LARC 60, an old land-sea standby, is unloaded on the shore after transporting a truck with container from the containership.

ALLIS-CHALMERS side-loader, one of several commercial items to be tested, places a container on an Army cargo vehicle.

Foreign Science and Technology . . .

Intelligence system for collecting information on R&D activities in other nations is vital to guide U.S. effort

Much of the effectiveness of the Army's research, development, testing, and evaluation (RDTE) function depends on accurate and timely data concerning foreign scientific and technical developments.

In developing weapons, weapon systems, materiel and counter measures, the U.S. Army must consider the characteristics, capabilities, and limitations of potential enemy materiel. Going a step further, unique ideas, techniques and materiel applications developed anywhere must be considered to reduce U.S. development lead time and costs to a practical minimum.

Thus, intelligence concerning foreign materiel and weapon system developments, trends and forecasts is essential to the decision-making process at all levels of management.

Command and operational control of the Army scientific and technical intelligence (S&TI) function (other than medical) comes under the Army Materiel Command (AMC).

While over-all management of the Department of Defense (DoD) scientific and technical intelligence program is exercised by the Defense Intelligence Agency (DIA), the Assistant Chief of Staff for Intelligence (ACSI), Department of the Army (DA), is charged with general staff supervision of Army S&TI production.

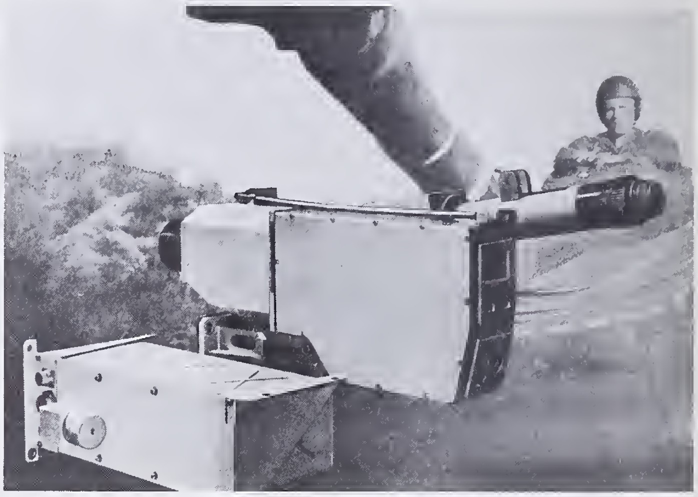
Within AMC, the Director of Research, Development and Engineering serves as the Foreign Intelligence Officer. He directs all AMC foreign intelligence activities, including the scientific and technical intelligence function.

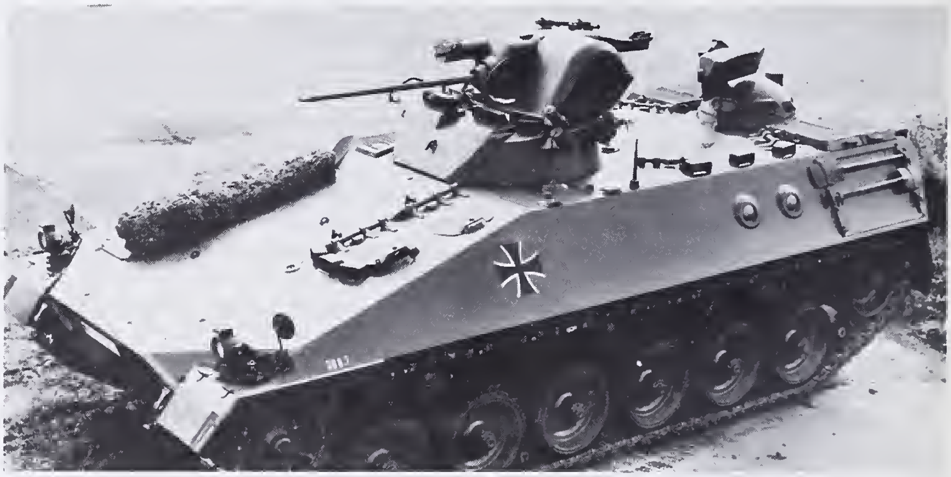
Ensuring that the S&TI effort supports DoD, DA, and AMC requirements, the AMC director sees that the research and development (R&D) system utilizes appropriate foreign intelligence to develop materiel that is operationally superior to that of potential enemies.

Involved in the AMC intelligence network are the Foreign Science and Technology Center (FSTC) in Charlottesville, Va., the Missile Intelligence Agency (MIA) at Redstone Arsenal, Ala., and nearly 50 Foreign Intelligence Offices (FIO) at AMC installations throughout the United States.

Another agency producing S&TI is the Medical Intelligence Office (MIO), Office of the Surgeon General, which is concerned with the foreign research and development of any concept, method, technique, instrument or material that may be used in the diagnosis and treatment of any disease or injury of interest to the U.S. Army.

Under the staff supervision of AMC's Foreign Science and Technology Division, the FSTC and MIA help provide the information for the interface between intelligence and R&D. The over-all structure of both is designed to


French M339 Tank Laser Rangefinder


West German "Marder"

Russian "Hormone" Helicopter

Russian Parachutes, PD-6r (right) and P2-41a Employed in Paradrop

provide the best available support for planning and conducting R&D programs aimed at technological superiority.

Approximately 50 percent of FSTC's effort and 35 percent of MIA's is in direct or indirect response to AMC R&D requirements.

Foreign Intelligence Officers have a 3-fold job: they serve as FI advisers to their respective commanders, provide needed intelligence to all elements of their command, and coordinate professional support from the R&D system needed by Intelligence organizations.

FSTC, a Class II AMC activity, and MIA, which is under MICOM, provide all-source, worldwide foreign scientific and technical intelligence to AMC subordinate commands and other military commands and activities of the U.S. Government. This intelligence, in response to validated production requirements, concerns sciences, technologies and ground forces items (except medical).

The total AMC foreign intelligence system, then, consists of the director of Research, Development and Engineering; Foreign Science and Technology Division/RD&E Directorate (exercises management of the system); Foreign Science and Technology Center; Missile Intelligence Agency; AMC Scientific and Technical Information Team, Europe; AMC Scientific and Technology Center, Far East; AMC Scientific and Technical Information Team, CONUS; and Foreign Intelligence Offices.

The team in Europe and the center in the Far East provide liaison and scientific and technical support, while the CONUS team coordinates the receipt and testing of foreign materiel. Foreign Intelligence Offices, in each separate laboratory, each major subordinate command and their subordinate installations and activities, serve as the interface between the AMC intelligence users and the U.S. intelligence community.

In general, the collection and production of scientific and technical intelligence is supported by the OMA appropriation. Collection and exploitation of enemy foreign materiel is supported by both the OMA and RDTE appropriations. The latter also supports acquisition and exploitation of non-enemy foreign materiel and the operations of AMC Foreign Intelligence Offices.

The cycle of R&D-Intelligence interface is completed by AMC contracts with industrial and educational organizations for intelligence study support, and for certain classified studies of advanced Soviet research activities. In addition, Army scientists are invited to participate in intelligence symposia.

In all these ways, Army policy is kept current by continuous consideration of foreign developments and threats as they affect U.S. R&D activities. This is the keystone of the Army's unrelenting effort to field operationally superior materiel for national defense.

As stated in Army Regulation 705-5, "Foreign state-of-the-art and potential threats to present and future materiel and systems must be considered throughout the development cycle to insure that the desired level of operational superiority is achieved when the item is fielded."

That basic policy statement, as related to all U.S. Army research and development programs, may be considered equally applicable as a policy for R&D on major weapon systems throughout the Department of Defense.

Swiss "Skyguard" Fire Control System

R&D NEWS . . .

Edgewood Arsenal Researchers Develop Pollution Abatement Chemical Compounds

Chemical compounds that reportedly could play a major role in establishment of pollution abatement measures were announced in April as a new development by two Edgewood (Md.) Arsenal research chemists, in collaboration with two industrial chemists.

Dr. George M. Steinberg, chief of the Biochemistry Section of the arsenal's Biomedical Laboratory, and Claire N. Lieski, a senior research chemist, worked with Drs. Peter Blumbergs and Arthur B. Ash of Ash-Stevens Inc., Detroit, Mich.

Their discovery is a group of organophosphorus compounds that function in a manner similar to commercial insecticides (Malathion, Parathion and Systox) but which can be degraded easily to nontoxic fragments.

The government-industrial team has filed a U.S. Patent covering their discovery and its use. A great potential is envisioned for the compounds in removing body pests from man and animals and for spraying food products shortly before harvesting.

Degradation is accomplished readily by washing the pesticides with mild alkaline reagents, such as sodium bicarbonate or soap solutions, so applications can be made for controlled periods of time. An important aspect is the speed with which cholinesterases can regenerate after reaction with the compounds.

Dr. Steinberg points out that this desirable feature is the result of built-in neighboring chemical groups which cause easy degradation. "If an unusually high concentration of pesticides were to accidently penetrate the animal body, recovery from poisoning symptoms should be rapid," he explained.

DR. STEINBERG is a native of Brooklyn, N.Y., with bachelor's degree in chemistry from Brooklyn College in 1940. He was awarded a master's degree (1943) in analytical chemistry and a doctorate (1945) in organic chemistry from Purdue University.

During his World War II military service he was assigned to the Army's Manhattan Project and conducted research at Columbia University, N.Y., in Oak Ridge, Tenn., and in Dayton, Ohio.

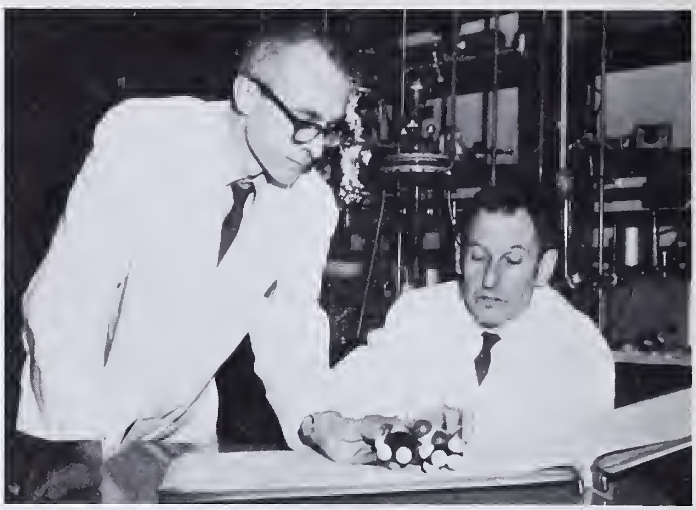
He began his Civil Service career at Edgewood Arsenal in 1948 and was the recipient of a Sustained Superior Performance Award in 1958. Author or coauthor of more than 50 scientific publications, he holds 14 U.S. Patents and serves on numerous Edgewood Arsenal and civic community panels and committees relating to scientific research.

CLAIRE LIESKE has served in Edgewood Arsenal's Biomedical Laboratory since 1963. He received a Department of Army Commendation in 1965 and a Sustained Superior Performance Award in 1968.

An attractive feature of the new pesticides, he said, is their "relative ease of detoxification under conditions normally encountered or easily provided for in the environment. Their use on field crops will not produce any ecological burden."

A native of Grand Rapids, Minn., he has received a bachelor of science degree in chemistry from the University of Idaho, and a master's degree in chemistry from the University of Maryland. A Phi Beta Kappa, he has authored or coauthored 24 scientific publications.

His professional affiliations include the American Chemical Society, the American Association for the Advancement of Science, and the Scientific Research Society of America.



COOPERATIVE EFFORT. Dr. George M. Steinberg (right) and Claire N. Lieske examine molecular models related to a new series of organophosphorous compounds discovered in association with Dr. Peter Blumbergs and Arthur Ash, Ash-Stevens, Inc.

New Committee Assesses Behavioral Research

Army-wide requirements for applied research in the behavioral sciences are being identified and assessed, and orders of priority are being determined, by a newly organized Program Development Advisory Committee.

The PDAC, comprised of representatives of Army General Staff Agencies and major commands, is established under provisions of TAG (The Adjutant General) Letter dated Mar. 7, 1972, subject: New Program Procedures in Human Resources Research and Development.

The PDAC constitutes a Department of the Army means of providing Army-wide direction to the planning and programing of behavioral sciences (human factors) research. The process will be similar to the procedures used in generating requirements for "hardware" research and development.

The PDAC consists of representatives of the Chief of Research and Development (OCRD), i.e., the Director of Army Research; Deputy Chief of Staff for Military Operations; Deputy Chief of Staff for Personnel; Deputy Chief of Staff for Logistics; Chief, Office of Reserve Components; and Assistant Chief of Staff for Force Development; Assistant Chief of Staff for Intelligence; CG, U.S. Continental Army Command; CG, U.S. Army Materiel Command; CG, U.S. Army Combat Developments Command; and such other Army general staff agencies and commands as may be agreed between the Chief of R&D and the agency/command concerned. An officer from OCRD will serve as executive secretary for PDAC.

The PDAC is assigned the following functions:

- Prepare the annual Department of the Army human resources research and development needs from problem statements submitted to the Chief of Research and Development by Army commands and agencies.
- Assign each problem statement to one of the six Director of Defense Research and Engineering categories of research: human performance; human engineering; personnel selection, classification, and utilization; education and training; strategic planning and overseas operations; and manpower planning.
- Assign a priority to each problem within each category of research.

The functions of OCRD, the Army Study Advisory Committee (ASAC), and its Working Group (WASAC) in the development of the Human Resources Research and Development Program are:

- OCRD will establish that portion of the Human Resources Research and Development Program devoted to the expansion of the technological base for present and future human factors research. An annual summary of the nature, scope and level of effort devoted to technological base research will be provided to WASAC-ASAC for information.
- OCRD will determine from the PDAC's prioritized and categorized problems the level of effort and time required to support those that are researchable. OCRD will provide to WASAC-ASAC for review the researchable problem statements as categorized and prioritized by the PDAC with identification of which proposals are to be funded, estimated level of effort, and time required.
- WASAC-ASAC will review the problem statements and priorities, deliberating as required with the originating agency or command.
- Following the ASAC review, OCRD will establish the Human Resources Research and Development Program, based on Army needs and priorities as determined by the PDAC and ASAC reviews.

Army Airfields Receiving Improved Communications-Electronics Systems

Improved communications-electronics systems will be provided at Army airfields and heliports throughout the Free World as part of a complete upgrading of some 90 sites over the next three years.

The U.S. Army Communications Electronics Engineering Installation Agency-Western Hemisphere (CEEIA-WH) is installing the equipment. CEEIA-WH is part of the worldwide Strategic Communications Command (STRATCOM), also headquartered at Fort Huachuca, Ariz.

LTC Clinton B. Dehrkoop, agency commander, said eight teams will perform the work throughout the continental United States and Hawaii as well as in Europe and the Pacific areas. The first team departed recently to work in the Republic of Germany. Six to eight weeks will be required to upgrade each site.

Under the program VHF, UHF and FM radio communications will be standardized and the VHF omnirange and VORTAC (visual omnirange tactical radar) systems will be revamped. Marker beacons and instrument landing systems and ground control approach radar systems also will be reconfigured.

Until recently there was no standardization of the electronics equipment at Army airfields and heliports. This situation existed because there was neither a standard engineering package nor common engineering drawings. The problem was compounded by the rapid expansion of facilities during the Vietnam buildup.

As a result, each airfield communications and navigational facility was engineered and built by local commanders using available talent and equipment.

Among the advantages of standardization are easier maintenance, greater safety and reliability, and less cost in funds and time in replacing old or obsolete equipment.

Another important part of the upgrade is the installation of emergency back-up power packages at the facilities. Equipped with automatic start and change over capabilities, these packages offer a definite advantage in times of such natural disasters as earthquakes and floods.

AVIONICS equipment repair supervisor SFC Johnny M. Minton, who will head one of eight teams upgrading Army airfields for the U.S. Army, inspects communications antenna atop air traffic control tower.

LWL Develops New Kit to Check Water Quality

Chemical quality of raw or treated water for consumption can be determined simply and reliably with a new 5-pound kit developed by the U.S. Army Land Warfare Laboratory in response to a Vietnam requirement.

Development was initiated in response to a study by ACTIV (Army Concept Team in Vietnam), showing the chemical detection kit in the supply chain was unsuitable in the Vietnam environment. This Standard B 75-pound kit had drawers that warped shut, and its contents were subject to breakage and deterioration.

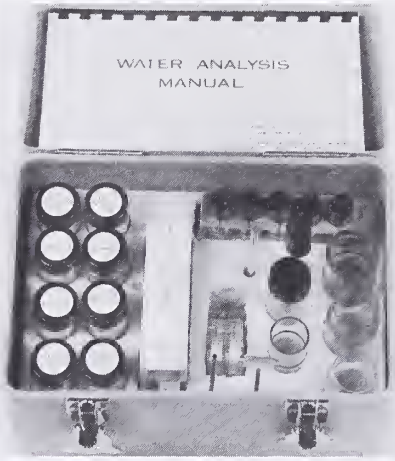
A commercial kit modified as an emergency replacement according to Army Corps of Engineers specifications weighs 35 pounds and requires considerable manipulation of fragile glassware.

The new LWL kit has a minimum of glassware, measures 9 × 6 × 6 inches, and uses techniques completely different than former methods. Eliminated is the need of preparing reagents, performing titrations and other tedious measurements.

Most of the tests are conducted by dipping a paper or plastic strip into the water sample and reading the height of a column or comparing the color obtained to a chart. No complicated calculations are required. The photograph below shows the kit and some of its components.

As in the older kits, water samples can be examined for pH, acidity, alkalinity, chlorine residual, chlorine demand, chloride, sulfate, turbidity and coagulation characteristics. Each kit contains enough material to examine at least 50 water samples for each of the above characteristics before requiring refill.

The simplicity of the kit allows personnel with little or no training to use it effectively. The kit has been successfully field-tested at LWL and is scheduled for more extensive evaluation by the Corps of Engineers in the very near future.



LWL Water Analysis Kit

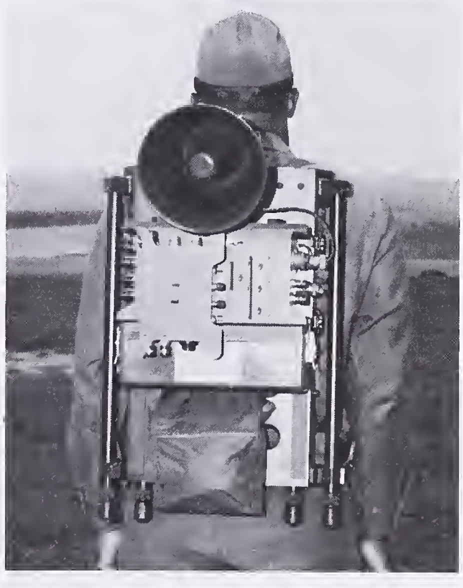
Army, Marine Corps Evaluate New Public Address System

A 65-pound high-power public address system, the AN/UIQ-10, developed by the U.S. Army Land Warfare Laboratory (LWL) and the U.S. Marine Corps, is being evaluated by the Marine Corps Development Center at Quantico, Va., and by the Army at Fort Benning, Ga.

The basic system delivers 250 watts from a 24-volt d.c. power supply. The high audio power, with low weight, is achieved by the use of pulse-width modulation of a 50 KHz carrier. The unit can be backpacked when the weight is divided.

The photograph at the right shows the 35-pound portion of the system assembled to provide a power of 60 watts. Under quiet conditions, this unit provides a public address capability at ranges up to 1,000 yards. If more power is needed, three additional speakers—part of the total load of 65 pounds—can be attached to the power amplifier.

The AN/UIQ-10 is designed for a standard line of military batteries and can be used in vehicles and aircraft with the available 28-volt power supply. Twenty-four of the systems have been manufactured by the Bendix Field Engineering Corp. at Columbia, Md. Project engineers are Stanley D. Peirce of the LWL, Aberdeen Proving Ground, Md. and Michael I. Keller of U.S. Marine Corps headquarters.



AN/UIQ-10 PA System

OCRD Activates Science & Technology Division

Activation of a new Science and Technology Division as a major component of the Directorate of Army Research, Office of the Chief of Research and Development, HQ Department of the Army, was effected Apr. 3.

The S&T Division consolidates functions of the former Research Technology Division and the Laboratory Review Office. COL Wallace H. Hubbard, who has served since No. 1, 1971, as Assistant Director of Army Research and CO of the Army Research Office, is the acting chief.

Additional S&T Division responsibility includes maintenance of a total overview of Army exploratory development (6.2 budget category) as well as the basic research (6.1) program; also, staff responsibility for policy and procedural matters in management of Army R&D laboratories.

One of the major goals of the S&T Division will be to achieve a proper over-all balance within the 6.1 and 6.2 programs; also, to provide a "coupling" between the Army's technology needs and development of the required technology within the time phasing of programed objectives.

In serving this pupose, the S&T Division will make periodic presentations during the annual budgetary review process to describe trends in allocation of technological resources. An over-all evaluation of the contribution of these technological efforts to the operational capabilities of the Army will also be made.

Other divisions of the Office of the Chief of Research and Development will continue to monitor and administer their assigned 6.2 projects, but will coordinate with the S&T Division on major changes in requirements or content of programs.

"A great deal of attention," it was explained, "will be given to exploitation at Department of the Army Staff level of new management techniques and procedures being introduced by the developing agencies—that is, agencies concerned with development of materiel and tactics."

Examples of new concepts to be addressed by the S&T Division are single program element funding (SPEF), Project REFLEX operational principles, and the Lead Laboratory designation in major program areas. The division also is charged with insuring that research and exploratory development considerations are included in Department of Defense and Army planning documents.

In concept the new division is "unstructured," but its responsibilities can be divided generally into two separate functional areas. Technology overview and coupling will be accomplished by seven officers specializing in the separate areas of: mobility; missiles; electronics; weapons; environmental technology; soldier support; and nuclear-chemical-biological (NCB) technology.

In the other area, laboratory review and technical coordination will be performed by a team of staff officers and analysts.

Initial personnel assignments in these areas are: Dr. Robert J. Heaston, missile technology; LTC Robert A. Bonifacio, mobility technology; MAJ Curtis G. Unger, NCB technology; LTC William A. Walker, electronics technology; LTC Vernon B. Sones, soldier support technology; MAJ Bernard P. Manderville, weapons technology; and LTC Melvyn D. Remus, environmental technology; LTC Harry D. Collins and LTC Edward E. Chick, laboratory review; Donald J. Ertel, laboratory management analyst; LTC John F. Ingman and LTC William T. King, technical coordination; and James W. Sterling, physical science administrator.

The laboratory review element of the division will remain in the Pentagon. Plans have been made to move the remaining staff of the division to the Pentagon in the near future, but initially it will remain collocated with the Army Research Office in the Highland Building, 3045 Columbia Pike, Arlington, Va.

Research Engineers Patent Med Evac System

A medical evacuation system, featuring a "powered litter rack" for faster loading and unloading of the wounded, has been patented by research engineers at the Eustis Directorate, Army Air Mobility R&D Laboratory, Fort Eustis, Va.

Inventors Richard E. Lane and Jules A. Vichness believe their system can air evacuate wounded personnel three times faster and with less supporting personnel than current systems.

As shown in the artist's concept below, two men carry the litter to the side of the aircraft. Aided by one man aboard the aircraft, the lead man guides the front skids of the litter onto metal guide-tracks anchored on the floor of the aircraft.

The rear litter bearer shoves the unit forward where it is automatically locked into place. The litter is then raised by electric power or hand crank to a position high enough from the base to permit insertion of a second litter, which in turn is raised to make room for a third litter.

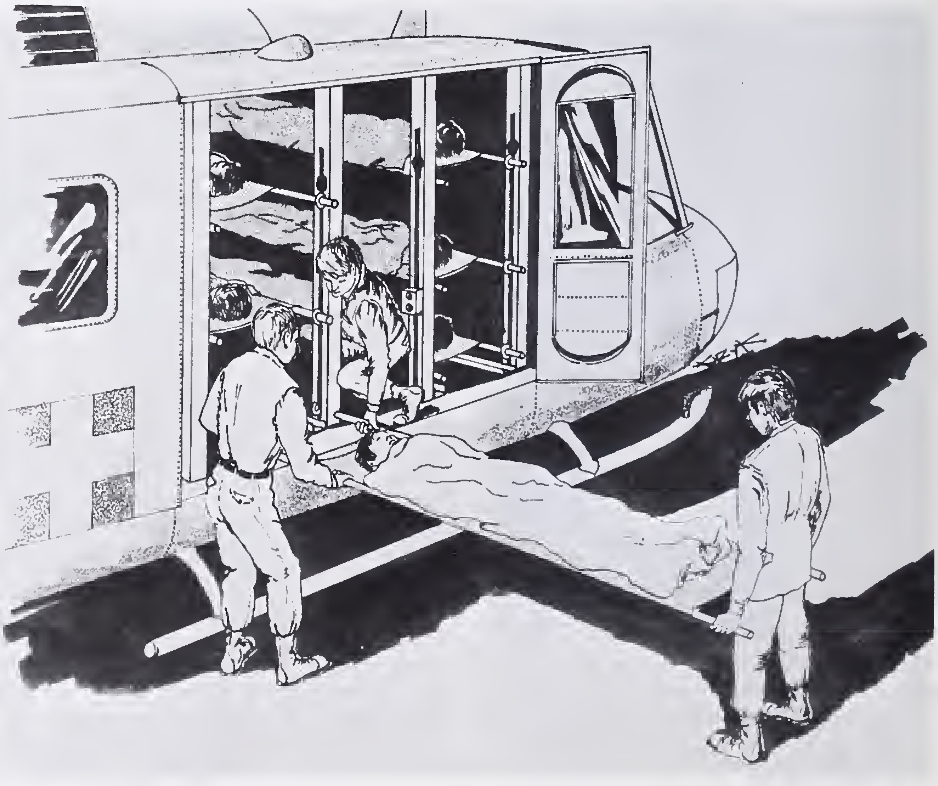
With the two litter racks supporting six litters, all securely locked in place, the aircraft is ready to head for a hospital base within a few minutes.

The time saved by easy access to the litter racks from either side of the aircraft, Army medics point out, could mean the difference between life and death—especially when there is need to get out of range of enemy ground-fire.

Interiors of current aircraft would have to be redesigned to accommodate the litter unit. The new approach, the inventors explain, was created with the Utility Tactical Transport Aircraft System (UTTAS) in mind.

Now under development by the Army, the UTTAS twin-engine aircraft will be designed to carry a squad of 11 fully equipped infantrymen, plus a 3-man crew.

Lane, an aerospace engineer with the Aircraft Subsystems and Equipment Division, and Vichness, a mechanical engineer who is a specialist in Army aircraft cargo handling systems, received official Army commendations and shared a $100 prize for their invention.



R&D NEWS

Plane With Rotating Cylinders in Wing Flaps Tested At Ames Research Center as Joint Army, NASA Effort

Rotating cylinders built into the leading edge of the wing flaps are a novel feature of a research aircraft being flown in tests at the Ames Research Center, Moffett Field, Calif.

The flight research program is a cooperative effort by the U.S. Army Air Mobility Research and Development Lab and NASA.

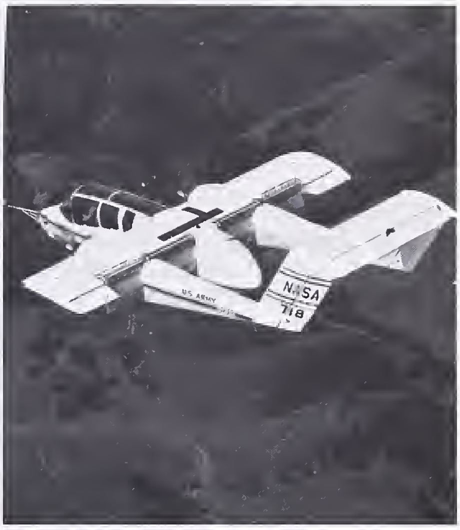
Installed on a modified YOV-10A aircraft, the rotating cylinder flap system is being used for research in STOL (Short Take-off and Landing) aircraft characteristics. Modifications include larger engines with new propellers interconnected so that either engine can drive both propellers and the rotating cylinders.

The experimental cylinders on the YOV-10A extend across approximately two-thirds of the wing span and protrude slightly into the airflow over the wing. When the cylinders are rotated rapidly in the direction of airflow, the exposed surface of the cylinder induces the propeller slipstream to flow smoothly across the wing and deflected flap.

Wind tunnel tests showed that smoother air flow across the upper surface of the wing and deflected flap greatly increases available lift. High lift is necessary for the low forward flight speeds and the steep landing approach capability required for STOL operations.

Rotating cylinder flaps are among several concepts being investigated for possible application to improve flight performance of future military or commuter STOL aircraft.

The rotating cylinder flap concept was invented by Alberto Alvarez-Calderon, a former research associate at Stanford University.



YOV-10A TESTBED AIRCRAFT used by the U.S. Army Air Mobility Research and Development Laboratory and NASA to test rotating cylinder wing-flap at Ames Research Center, Moffett Field, Calif.

Labor Department Offers Aid To Jobless Aerospace Workers

Jobless aerospace and defense engineers, scientists, and technicians anywhere in the United States are now eligible for retraining and job-finding services under the Labor Department's "Technology Mobilization and Reemployment Program."

Interested individuals should contact their State Employment Service for details.

Land Warfare Laboratory Develops Lightweight, Automatic Flotation Device

The U.S. Army Land Warfare Laboratory, Aberdeen (Md.) Proving Ground, has developed a flotation device weighing only two pounds that supports in water a soldier carrying 60 pounds of field gear.

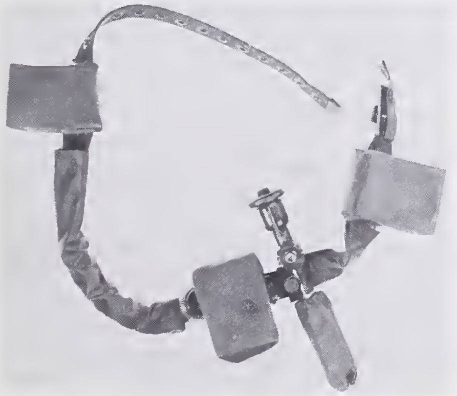
After inflation, the device positions a bladder under each arm and one under the chin, keeping the user in a vertical position. This provides confidence to the nonswimmer, and holds the face of an injured or unconscious man out of the water.

The bladders are designed with a 2-way check valve, eliminating the possibility of all three bladders deflating in the event of a puncture to one either before or after inflation. Two bladders provide adequate bouyancy to float a man carrying 60 pounds of equipment.

Worn above the pistol belt, the unit can be used with the rucksack, combat gear or parachute harness. The bladders can be inflated by pulling the manual pull knob on the CO_2 canister. The inflator also can be set to work automatically when submerged in two feet of water. If an emergency arises and the CO_2 canister has been used, the bladders can be inflated orally.

The automatic valve requires both pressure and water to activate the CO_2 canister, eliminating inadvertent activation by weather or weapons concussion. The automatic valve is simple and can readily be made reoperable in field without the use of tools. The manual mode requires only the replacement of the *CO_2 cannister to put the unit in operation.

The flotation gear is available in two waist sizes, one to fit American soldiers and one to fit the Vietnamese soldiers, has a quick release buckle and provides adequate instructions for repacking and recharging in the field.



Nixon Proposes United R&D Effort...

Message to Congress on Science and Technology requests action to strengthen economy, improve the quality of life

President Nixon is calling for a "strong new effort" to marshall the power of science and technology as a means of strengthening the U.S. economy and improving the "quality of life."

In a recent special "Science and Technology" message to Congress, the Chief Executive proposed united effort by federal, state and local governments, business, industry and educational institutions in a cooperative pursuit of progress.

The President said "the ability of the American people to harness the discoveries of science in the service of man has always been an important element in our national progress. . . . This capacity has undergirded both our domestic prosperity and our international strength."

As for "new challenges of the 1970s," the President wants the nation to benefit from the enormous investments in research and development already made by the U.S. Government and private enterprise.

"The importance of technological innovation," he said, "has become dramatically evident in the past few years. By fostering greater productivity, technological innovation can help us to expand our markets at home and abroad, strengthening old industries, creating new ones, and generally providing more jobs for the millions who will soon be entering the labor market.

"This work is particularly important at a time when other countries are rapidly moving upward on the scientific and technological ladder, challenging us both in intellectual and in economic terms. Our international position in fields such as electronics, aircraft, steel, automobiles and shipbuilding is not as strong as it once was. A better performance is essential to both the health of our domestic economy and our leadership position abroad.

"At the same time, the impact of new technology can do much to enrich the quality of our lives. The forces which threaten that quality will be growing at a dramatic pace in the years ahead. One of the great questions of our time is whether our capacity to deal with these forces will grow at a similar rate. The answer to that question lies in our scientific and technological progress.

"In pursuing this goal, it is important to remember several things. In the first place, we must always be aware that the mere act of scientific discovery alone is not enough. Even the most important breakthrough will have little impact on our lives unless it is put to use—and putting an idea to use is a far more complex process than has often been appreciated. To accomplish this transformation, we must combine the genius of invention with the skills of entrepreneurship, management, marketing and finance.

"Secondly, we must see that the environment for technological innovation is a favorable one. In some cases, excessive regulation, inadequate incentives and other barriers to innovation have worked to discourage and even to impede the entrepreneurial spirit. We need to do a better job of determining the extent to which such conditions exist, their underlying causes, and the best ways of dealing with them.

"Thirdly, we must realize that the mere development of a new idea does not necessarily mean that it can or should be put into immediate use. In some cases, laws or regulations may inhibit its implementation. In other cases, the costs of the process may not be worth the benefits it produces. The introduction of some new technologies may produce undesirable side effects. Patterns of living and human behavior must also be taken into account. By realistically appreciating the limits of technological innovation, we will be in a better position fully to marshal its amazing strengths.

"A fourth consideration concerns the need for scientific and technological manpower. Creative, inventive, dedicated scientists and engineers will surely be in demand in the years ahead; young people who believe they would find satisfaction in such careers should not hesitate to undertake them. I am convinced they will find ample opportunity to serve their communities and their country in important and exciting ways.

"The fifth basic point I would make concerning our over-all approach to science and technology in the 1970s concerns the importance of maintaining that spirit of curiosity and adventure which has always driven us to explore the unknown. This means that we must continue to give an important place to basic research and to exploratory experiments which provide the new ideas on which our edifice of technological accomplishment rests. Basic research in both the public and private sectors today is essential to our continuing progress tomorrow. All departments and agencies of the Federal Government will continue to support basic research which can help provide a broader range of future development options."

Citing that 55 percent of the nation's research and development expenditures are presently funded by the U.S. Government, the President said "a good part of our Federal effort in this field has been directed in the past toward our national security needs."

To ensure the nation's strategic deterrent capability, the continued modernization of the Armed Forces, and a strong over-all technological base for future military systems, he said he has proposed a substantial increase for defense R&D for FY 73.

In this message, however, he focused on ways to apply scientific resources in meeting civilian needs. He urged Congress to support the various elements of this new federal strategy, saying:

"We are reorienting our space program to focus on domestic needs—such as communications, weather forecasting and natural resource exploration." One way of doing this, he noted, is by designing and developing a reusable space shuttle.

He spoke of other civilian research and development targets. Among them:

- Providing new sources of energy without pollution.
- Developing fast, safe, pollution-free transportation.
- Working to reduce the loss of life and property from natural disasters.
- Improving drug abuse rehabilitation programs and efforts to curb drug trafficking.
- Increasing biomedical research efforts, especially those concerning cancer and heart disease, and generally providing more efficient and effective health care, including better emergency health care systems.

Pointing to the excessive risks facing individual companies in certain projects, President Nixon recommended federal support of private research and development through cost-sharing agreements, procurement policies or other arrangements.

"I believe it is appropriate," he said, "for the Federal Government to encourage private research and development to the extent that the market mechanism is not effective in bringing needed innovations into use."

For example, he cited the sheer size of some developmental projects as being beyond the reach of private firms, particularly in industries which are fragmented into many small companies.

Viewing "an asset unused as an asset

wasted," the President spoke of federal research and development activities generating a great deal of new technology which could be applied in many ways, explaining:

"In such cases, I believe the Government has a responsibility to transfer the results of its research and development activities to wider use in the private sector."

To further this objective, he said the National Technical Information Service (NTIS) was created in the Department of Commerce in 1970.

In addition to the NTIS, the new incentives programs of the National Science Foundation and the National Bureau of Standards will seek effective means of improving and accelerating the transfer of research and development results from federal programs to a wide range of potential users.

As a further step in applying government-sponsored technologies to the private sector, the President said he has directed his Science Advisor and the Secretary of Commerce to develop plans for a new, systematic effort to promote actively the licensing of government patents—also, to obtain domestic and foreign patent protection for technology owned by the U.S. Government to promote its transfer into the civilian economy.

Advocating an improvement in the climate for innovation, he suggested ways in which the U.S. Government can influence the level and quality of private research and development. Policies concerning tax, patent procurement, regulation and antitrust matters were mentioned as "having a significant effect on the climate for innovation."

Legislation will be submitted, he said, to encourage the development of the small, high technology firms which have had a distinguished pioneering record. This proposal would provide additional means for the Small Business Investment Companies (SBICs) to improve the availability of venture capital to such firms.

The President proposed that further stimulus for improving the climate of innovation be generated by these additional actions:

- Setting up new programs by the National Science Foundation and the National Bureau of Standards to determine effective ways of stimulating non-federal investment in research and development and of improving the application of R&D results.
- Providing a focal point within the Executive Branch for policies concerning industrial research and development by having the Department of Commerce appraise on a continuing basis the technological strengths and weaknesses of American industry.
- Fostering useful innovation by establishing a new program of research and development prizes to be awarded by the President for outstanding achievements by individuals and institutions.
- Changing to the metric system of measurement in world trade.

Stressing the need for stronger federal, state and local partnerships, the message outlined procedures to be implemented in achieving this goal. Included is a recommendation to give state and local governments a central role in the application process which utilizes the research and development resources amassed by the U.S. Government.

To implement this plan, the President said he will direct his Science Adviser, in cooperation with the Office of Intergovernmental Relations, to serve as a focal point for discussions among various federal agencies and representatives of state and local governments. He suggested for discussion:

- Systematic ways for communicating to the appropriate Federal agencies the priority needs of state and local governments, along with information concerning locally-generated solutions to such problems.
- Ways of assuring state and local governments adequate access to the technical resources of major federal research and development centers; and
- Methods whereby the Federal Government can encourage the aggregation of state and local markets for certain products so that industries can give government purchasers the benefits of innovation and economies of scale.

The President's message also covered the need for world partnership in science and technology. "The laws of nature transcend national boundaries," he said. "Increasingly, the peoples of the world are irrevocably linked in a complex web of global interdependence—and increasingly the strands of that web are woven by science and technology."

To promote the goal of benefiting from the experience of other countries as the United States shares information and facilities with them, the President said he will direct federal agencies, under the leadership of the Department of State, to identify new opportunities for international cooperation in research and development. At the same time, he will invite other countries to join in research efforts in the United States, including:

- The effort to conquer cancer at the unique research facilities of the National Institutes of Health and at Fort Detrick, Md.
- The effort to understand the adverse health effects of chemicals, drugs and pollutants at the new National Center for Toxicological Research at Pine Bluff, Ark.

"These two projects," the President said, "concern priority problems which now challenge the whole world's research community. But they are only a part of the larger fabric of cooperative international efforts in which we are now engaged."

He spoke of science and technology providing important links with countries having different political systems. As an example, he mentioned an agreement recently concluded with the Soviet Union in the field of health, providing for joint research on cancer, heart disease and environmental health problems.

Another agreement, this one resulting from his recent visit to the People's Republic of China, will facilitate, he said, the development of contacts and exchanges in many fields, including science and technology.

The President spoke of taking steps to initiate a broad review of U.S. involvement in the scientific and technological programs of international organizations. He also mentioned the "steps that might be taken to make United States participation in these activities more effective, with even stronger ties to our domestic programs."

In the realm of world partnership, he emphasized that U.S. science and technology can and must play an important role in the progress of developing nations, and that "the years ahead will require a new sense of purpose and a new sense of partnership in science and technology."

President Nixon concluded his message with an appeal for the cooperative efforts of all concerned, stating:

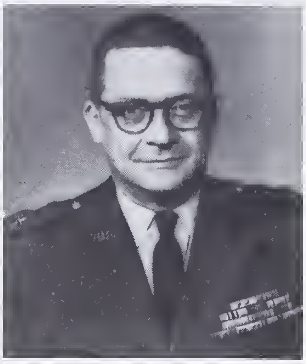
"The investment we make today in science and technology and in the development of our future scientific and technical talent is an investment in tomorrow—an investment which can have a tremendous impact on the basic quality of our lives. We must be sure that we invest wisely and well."

RAM Stressed as Priority Effort . . .

Materiel Command's MG Guthrie Tells AOA Chapter of Need for Army-Industry Teamwork on Reliability, Maintainability

U.S. Army Materiel Command Deputy CG for Materiel Acquisition, MG John R. Guthrie, addressed one of the Army's high priority areas of effort—accented by continuing cutbacks in funding and manpower resources—in speaking to the Washington Chapter of the American Ordnance Association.

MG Guthrie listed a number of what he termed "solid accomplishments" during 1971, including initiation of engineering developmental effort on the UTTAS (Utility, Tactical, Transport Aircraft System) and the Heavy-Lift Helicopter, and "a number of other advanced development programs that will provide prototypes for testing and operational demonstration in relatively short time frames." He also cited type classification of 98 items. He then turned to his main theme, as follows.


MG John R. Guthrie

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In developing and producing materiel, we are all concerned that we get the best product available, at reasonable cost, to satisfy our needs. Our job in the Army is to define the product that fills that bill—it is your job to produce it—on schedule and at reasonable cost.

One element of our strategy to make things better is to insure that proper consideration is given from design onward to a product's reliability, availability, and maintainability, or as we know it by the acronym—RAM—an area we may have slighted too often in the past.

My purpose here today is to assure you that our concern in this area is real—and that we in the Army intend to put our money where our mouth is. We intend to support during development RAM efforts which are oriented toward meeting requirements at reduced cost.

I don't want you to latch on the phrase "reduced cost," however, and forget about "meeting requirements." We must define requirements that can be met at reasonable cost and still provide the capability our fighting man needs. We are looking for our RAM efforts to help us reduce the costs of supporting that capability.

Let me give you an example of how this might be done.

Suppose the Army fields a fleet of 1800 utility helicopters that will each fly an average of 75 hours per month. In ten years, then, this fleet would have flown 16 million hours.

Now, after we accumulate some experience data, we find that it is costing us $19 per flying hour just to replace main rotor blades. This adds up to a total cost of $308 million in 10 years.

After further investigation, however, we find that if cracking and bonding failures of the blades could be eliminated, we would extend blade life and reduce the cost of replacement to $14.50 per flying hour. In ten years this could mean a reduction in support costs which could reach close to $75 million in replacing main rotor blades alone.

When we consider what we might achieve in the total aircraft system, the costs begin to numb the mind. Incidentally, these statistics are not imagined; they are based on historical experience data from our current utility helicopter fleet.

Now put yourself in the Army's position for a moment. Obviously, we want to invest the relatively small product improvement costs of eliminating blade cracking and bonding failures. But, more importantly, we cannot afford this kind of potential cost burden on new acquisitions. We view our RAM efforts as a primary means of assisting us to avoid it.

That is easy to say—but it will not be as easy to accomplish. We have some formidable problems blocking the path to achieving RAM requirements during materiel development and acquisition.

What then can we do to help us do this effectively? Our basic approach calls for defining quantitative RAM requirements, insuring their continued consideration beginning with the design process, demonstrating their achievement, providing for aggressive failure analysis and corrective action, and planning and managing RAM growth.

Defining Requirements: I expect most, if not all of you, are at least aware that the Army has developed a revised means of stating the technical requirements for an item to facilitate the necessary system trade-off analysis of cost, schedule and technical performance during conduct of a program.

In a single document called a Materiel Need, equipment requirements including those for RAM are stated in the form of bands of minimum and maximum operating and technical requirements.

These quantitative RAM requirements "set the stage" and define the scope of effort required to achieve them in development. They also become the "yardstick" against which we measure our achievements. Once established, we are then able to devise a valid test program to demonstrate RAM achievement in support of future production decisions.

We have not yet developed a good method of describing these requirements that "grabs" our masters. For example, the Scout Vehicle has a power train durability requirement described in terms of a "50 percent probability of operating 6,000 miles without replacement."

This requirement defines a power train well beyond anything in existence today, but, largely because of the manner in which it is expressed, it is considered marginal by senior managers. We need your help in getting better means of expressing our reliability, durability and maintainability needs so that they are readily understandable to reliability engineers and history majors alike.

RAM Input to Design. To insure the consideration of RAM requirements during the design process, we must include RAM engineers as active contributing members of design teams from the outset. These RAM engineers must prove to designers that their contribution will enhance the design. Too often in the past they have failed.

RAM Demonstration. Once we have set the requirements and included them in the design, to plan and manage RAM effectively, we must know two things. First, we must know what rate of RAM growth can be realistically achieved during development and subsequent production.

Second, since we view RAM growth as a quantitative yardstick with which to dimension, plan, manage, fund and monitor RAM development, we must know at any point in time what actual rate of growth we are in fact achieving.

Both actions require sound, statistically valid test programs, the final results of which must be timely and unequivocal. We are therefore emphasizing design that will produce test programs which will provide the basis for decisions at reasonable risk and at reasonable cost.

Since experience has shown that RAM requirements are seldom achieved by the initial design, such test programs must necessarily be iterative—and will seldom be inexpensive. We must therefore design them carefully, insuring that tradeoffs—size of sample, time, nature and number of tests—are thoroughly considered. We expect that we will be required to justify to the Congress the number of components/prototypes exposed to test.

We are also using simulation techniques where possible to reduce the cost of testing. For example, in our proof testing of gun tubes and breech mechanisms—which in the past has required live firing—we have found that the pressure/time cycle associated with live firing can be simulated by a device which uses small size blank cartridges. Using these techniques, we estimate savings of nearly $11 million over a 25 year economic life period.

Implementing RAM Improvements in Currently Fielded Systems. You may have discerned from my opening example that we do have equipment in the field today which was developed with less attention to RAM considerations. We have failures on these equipments that make them unavailable for use and costly to fix.

For example, the radio frequency modulator-oscillator used on the Hawk Missile System has a mean-time-between-failure of 592 hours—and its estimated maintenance cost for repair is 1,200 per failure incident; also, the clutch disc assembly on the 2½-ton truck fails on an average of every 3,456 miles, and costs $293 to replace.

Typically, these failure rates can be reduced through product improvement at a low risk, since upgrading components to the state-of-the-art is usually all that is required. We have a program oriented to solving these problems.

RISE: RAM Improvement of Selected Equipment. Here is how it works. RISE has four phases: Identification, analysis, action, verification.

First, a comprehensive survey of equipment components is conducted to identify those with high failure rates. These packages of data are arrayed from worst to best, in terms of cost, and we attack the worst ones first.

The analysis phase is the real heart of RISE. Here we establish, by careful engineering analysis, whether or not the component or part can be redesigned or modified to increase its reliability. If it is technically feasible, we develop the Life Cycle Cost of the newly designed part of component and compare it with the cost of continuing to use the existing item.

If this analysis says product improvement is cost effective, we proceed to the action phase. Here, the RAM improvements are again arrayed in order of merit, savings-wise, and we move out to fund the winners.

In the final or verification phase, we monitor the test and field performance of the improved hardware to satisfy ourselves that the improvements will actually pay off. The intelligence gained in this verification phase can also provide a base for establishing requirements for further development efforts on componentry.

We kicked off the RISE program in September 1969 and solid results are beginning to show. For example:

- Our M113 APC family has been using what is known as the T130 track with mean time to replacement of 2,000 miles. By changing to 4140 steel, we are getting 5,000 mean miles out of the track, with indicated 5-year savings of about 20 million dollars.
- Improvements to the compressor section of the T53 engine—used in our Huey Fleet—increased the mean removal time from 450 hours to 900 hours. Estimated 5-year savings are $14 million.
- We did some work on components of the ARC 114 Radio Set—doubled the mean-time-between-failure—and estimate our savings at $5 million.

I have gone into some detailed rationale because I hope to convey that we intend to put our dollars where there is real payoff—and not just product improve because it's a fashionable thing to do.

RAM R&D in Componentry. We intend to go still further—to attack those RAM problems which we do not know how to correct today. These problems will require concentrated research and development to arrive at effective solutions.

Through our RISE program and interface with the user, we intend to isolate those areas or components that need more research and development and fund the effort needed to upgrade them.

This brings me to my last and most important point—the difficulty of RAM achievement in the transition from development to production.

We have analyzed our track record on weapon system acquisition, with a view to getting at the specific causes of our past problems. One contributing factor, in particular, stood out inescapably—that our weapons systems contractors, with few exceptions, experience great difficulty with the transition from development to production.

These same contractors, in most cases, had demonstrated capability in design and development, and the systems they developed generally met design performance goals during prototype testing.

In most cases, the development phase was executed relatively close to cost-and-time estimates. When the time came to set up a hard-tooled production line and deliver reliable, conforming, production items, these same contractors have often literally fallen on their faces.

This is basically the contractor's problem, but we are attempting to help solve it by tailoring our programs to recognize this fundamental weakness. We plan to do this by initiating production, when development appears to be well along, by placing a small order—to be delivered at a low rate—over hard tooling.

Configuration control will not be assumed by the government until production items have passed production tests, and fixes are incorporated in the technical data package.

The Scout Vehicle Program, which calls for a hardware prototype competition of two or more significantly different approaches, will provide us with a test of this concept.

We will test the prototypes, select the better one, and place a contract with the winner for engineering and production of 35 vehicles built over hard tooling. When the 35th vehicle is delivered, we will shut the production line down.

As the 35 vehicles are delivered, engineering and service tests will be initiated followed by operational testing. Results of the tests will be cranked into the technical data package. Our plan provides for periods of up to a year to complete our testing and refine the technical data package before initiating volume production.

(Continued on page 16)

RAM Effort Stressed

(Continued from page 15)

This approach may not be applicable to all kinds of equipment, but we are optimistic that our experience with the Scout may offer a solution to the historic problem of transitioning from development to production.

In summary, RAM considerations impinge on every phase of the materiel life cycle. They are so all-encompassing that we do not view responsibility for RAM as falling exclusively under the purview of any single functional element at our major command level.

RAM consciousness is a responsibility of all functional elements. The wide scope of RAM activities throughout the organization means that RAM effectiveness depends on close and continuous attention at the highest levels of management. In AMC, they are getting just that.

Ladies and gentlemen, I hope you now have an insight into our effort to field better equipment through application of RAM disciplines. In the last analysis, we believe we measure our success by the quantity of simple, effective, reliable and maintainable equipment we provide to the soldier in the field. We believe our ability to achieve this goal has been and will continue to be improved as a direct result of efforts I have described.

DEMON Method Simplifies Microwave Circuit Design

Calculations for designing miniature microwave transistor amplifiers that formerly required months of tedious and complicated work are being accomplished in a week by a computer method called DEMON (Diminishing Error Method for Optimization of Networks).

Devised by V. G. Gelnovatch, an electronics engineer in the Electronics Technology and Devices Laboratory at Fort Monmouth, N.J., the time-and-money-saving operation permits rapid solution of complex equations involving as many as 30 variables of the amplifier.

In actual tests, engineers have supplied a completely designed, fabricated and tested microwave amplifier in about seven days, as compared to the three to six months previously required.

Fabrication of these circuits is centered around microminiaturization approaches involving transmission line components in microstrip form on ceramic substrates.

By using repetitive calculations, the computer seeks the best physical layout and dimensions of the deposited microwave pattern that will yield the desired electronic performance. In a typical design, about six million calculations are performed in six minutes as the computer "seeks" better solutions in a restorative process.

About 15 U.S. Government laboratories have been furnished programs and program information. In addition, about six industrial firms are using or exploring the DEMON approach for the design of new microwave circuits.

Gelnovatch, who heads the Microwave Integrated Circuits Team in the laboratory, declared his program is also applicable to the newer types of semiconductor circuits using diode, Gunn and avalanche devices.

HumRRO Announces Publication of Technical Reports

Four technical reports published and distributed recently by the Human Resources Research Organization (HumRRO) are:

TR 71-8, "A Descriptive Analysis of the Classification, Assignment, and Separation Systems of the Armed Services." This report describes the classification and assignment process applied to men entering military service, and the process for separation from the service.

TR 71-18, "Preliminary Handbook on Procedures for Evaluating Mental Health Indirect Service Programs in Schools," describes study conducted for the National Institute of Mental Health to develop methods and instruments for evaluating community mental health center programs of indirect consultation to schools.

TR 71-24, "Studies on Reduced-Scale Ranging Training with a Simple Range Finder," describes three experiments conducted on reduced-scale stadimetric ranging training. It should be of interest to those concerned with training for improving range estimation, visual surveillance, and aircraft and identification.

TR 72-5, "Studies of Aircraft Recognition Training," describes studies conducted in the development of aircraft recognition training for personnel in forward-area air-defense situations.

Samuel Assumes Command of CDC Maintenance

Command of the U.S. Army Combat Developments Command Maintenance Agency, Aberdeen (Md.) Proving Ground, was assumed recently by COL Robert W. Samuel.

A 1944 graduate of the U.S. Military Academy, West Point, N.Y., COL Samuel succeeds COL Donald H. Greeley, who retired after 30 years of military service.

Following a 1952–55 HQ Far East Command assignment, he attended the University of Michigan, Ann Arbor, Mich., and received a master of science degree in mechanical engineering in 1957.

COL Samuel then served three years at the U.S. Military Academy as an instructor and assistant professor in the Department of Ordnance. While at Aberdeen Proving Ground (1961–63) he was deputy director of the former Development and Proof Services, now Materiel Testing Directorate.

Following a 1963 assignment to the Republic of Vietnam, he was project officer and executive officer, Office of the Secretary of Defense, Advanced Research Projects Agency, Research and Development Field Unit.

COL Samuel served (1964–66) as chief, Chemical and Materiel Branch and Research Plans Office, U.S. Army Research Office, Office of the Chief of Research and Development, Department of the Army. He completed the resident course at the Industrial College of the Armed Forces in 1967.

Returning to Europe in 1967, he served as deputy commander, 3d Support Brigade, USAREUR until 1968 when he become commanding officer of the Brigade. Following 1969 duty as commander of HQ VII Corps Support Command, he became assistant chief of staff G-4, HQ VII Corps.

COL Samuel's awards and decorations include the Silver Star Medal, Legion of Merit with two Oak Leaf Clusters, Bronze Star Medal, Presidential Unit Citation, European-African-Middle East Campaign Medal, American Defense Service Medal, World War II Victory Medal, Army Occupation Medal (Germany), Korean Service Medal, National Defense Service Medal, American Campaign Medal, United Nations Medal, and the Vietnam Campaign Medal.

COL Robert W. Samuel

NBS Extends Micro Wave Service Into 55-65 GNZMM Wave Region

Extending its long established micro wave service into 55- to 65-GHz millimeter-wave region, the National Bureau of Standards has inaugrated interim millimeter-wave calibration service at the Boulder, Colo., laboratory.

Filling a need that has existed since the early days of millimeter wave research and exploration, the new facility can calibrate devices used to measure power, attenuation, impedance, antenna gain, and noise.

Additional information about the new NBS service, may be obtained by contacting F. X. Ries at (303)499-1000, Ext. 3561.

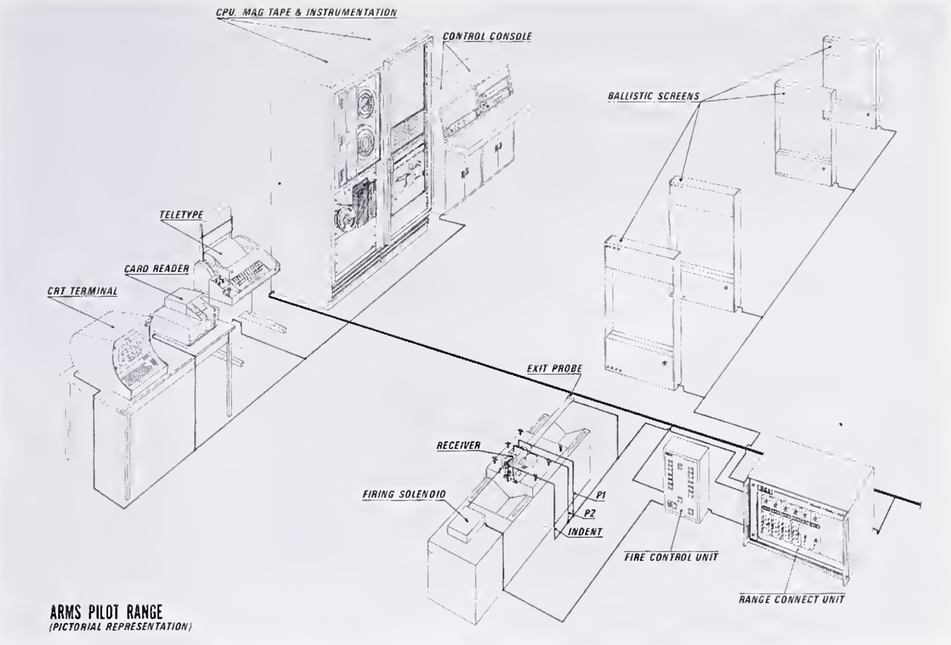
ECOM Scientific Adviser Elected as Museum Trustee

Dr. Walter S. McAfee, scientific adviser to the Army Electronics Command Director of Laboratories, is one of four new trustees of the Monmouth Museum.

Election of Dr. McAfee by the museum's board of directors was announced by museum president William B. Leonard. Other new members are Dr. Mason W. Gross, former president of Rutgers University; William W. Westerfield, a partner in Price Waterhouse and Co., and E. Donald Lass of Deal, managing editor of the Asbury Park Press.

Dr. McAfee started in 1971 as the first black in the Army Materiel Command to achieve the grade of GS-16 now held by nine ECOM personnel. While his current position covers the scientific spectrum, his latest specialized work is in quantum optics and laser holography.

Frankford Adopts ARMS Pilot System for Testing Small Caliber Ammunition



ARMS PILOT RANGE
(PICTORIAL REPRESENTATION)

Small caliber ammunition testing is achieving new standards of efficiency with an Automated Range Management System (ARMS), a new concept in ballistic range operation and control, at Frankford Arsenal in Philadelphia, Pa.

Through the use of a high-speed mini-computer and peripheral equipment, ARMS collects, reduces, transmits and stores test data, and has the potential to maintain complete housekeeping records on use and maintenance of test equipment. Range officers point out that the system also acts as a controller to insure that range safety measures are observed during firing operations.

Although the current ARMS pilot system was designed to test programs fired in a single range, engineers are analyzing the operations and data produced from one range to determine specific design criteria needed to expand the ARMS configuration to multi-range capability.

Frankford Arsenal's small arms testing complex has 32 ranges in addition to various support areas for maintenance and calibration of equipment and sensors. The modular concept of modern computer systems will allow expansion to include the entire range facility with minimal program alteration.

One beneficial offshoot of ARMS is the reduction of the manual calculating processes, summaries and analyses normally carried out during various stages of ballistic testing. All of these functions can be performed automatically with greater speed and positive accuracy.

Though the pursuit of ammunition analysis includes many investigations, one particular area that has immediate applicability to the ARMS is internal ballistics, a phase that concerns the measurement of gas pressures created upon ignition of propellant powders.

Today's partitioners employ standard copper cylinders when measuring gas pressures. Since the lengthy manual handling involved in their use precludes simple adaptability to a computer, the coppers are not suited to an automated system.

Ballistic engineers at Frankford Arsenal are studying the practicality of a piezo-electric transducer to replace the coppers within the automated system. By comparison, the piezo-electric transducer will automatically convert the ignition gas pressures to voltage readings sent to the computer. Results of each firing are measured by the transducer, recorded in computer memory, and compared with stored information reflecting acceptable standards. Internal analysis can therefore provide for immediate adjustment if required.

The environment of ammunition testing is such that strict adherence to acceptable standards prescribed by U.S. Army ammunition specifications is essential. In the area of internal ballistics, researchers have found that the piezoelectric transducer is the apparent answer when looking for an element that will significantly aid in assuring improved testing accuracy and reliability. The transducer has proven to be resilient and durable under harsh conditions, and fills the need for compatibility to an automated system.

Other data developed by the computer on internal ballistics include primer ignition time, propellant ignition time and action time.

Another important phase of ammunition testing is exterior ballistics: the observation and measurement of ballistic parameters from the time the projectile leaves the muzzle until it reaches the target. The ARMS at Frankford Arsenal includes the capability to measure projectile velocity efficiently and accurately.

The system utilizes ballistic screens, separated by a given distance, which record projectile passage at each screen location. The movement is noted as the projectile interrups a curtain of light beams at each ballistic screen. Interval time (elapsed time from one screen to another) is recorded in computer memory, divided into the given distance, and projectile velocity is calculated.

Projectile dispersion for accuracy is another phase of ammunition performance measurement which will interface with ARMS. Current accuracy tests require the time-consuming manual process of mounting paper targets for each firing test. While these tests provide reliable data, the method is not directly compatible with a computer-oriented data collection system.

Studies are now being conducted at Frankford Arsenal to evaluate an automated accuracy measurement system that eventually will be interfaced with ARMS. It represents a potential for greater consistency, speed and reliability in testing projectile dispersion.

Frankford Arsenal reports ammunition testing procedures have thus far kept pace with the demands placed upon the installation as the technology center for small-caliber ammunition in the Department of Defense network, and as the test center for all small-caliber ammunition used by the NATO countries.

Additional burdens will be placed upon the facilities after the completion of an automated line for the modernization of small-caliber ammunition manufacturing. The program is called SCAMP, for Small-Caliber Ammunition Modernization Program, and is believed unparalleled in the ammunition industry.

Arsenal officials believe that SCAMP will revitalize the ammunition production industry and that the testing methods must be updated accordingly. ARMS is the model of an automated test facility that can provide positive control on production quality by conducting ballistic tests and reporting data expediently and efficiently.

USACSC Executive Selected For Stanford University-Sloan Program

John W. Murray, director of Design Support, U.S. Army Computer System Command (USACSC), Fort Belvoir, Va., has been selected to participate in the Stanford-Sloan Program from September 1972 through June 1973 (sponsored by Stanford University), this program of intensive study in advanced management and the humanities is designed for the professional development of exceptional young executives.

IN RETROSPECT . . .

Management principles for scientific, engineering career fields offered 11 years ago by Dr. Siple are still valid

Who will receive the most coveted honor bestowed at the 1972 U.S. Army Science Conference, June 21–23, at the United States Military Academy?

The answer to that question is intriguing the largest field of prospective recipients in the history of the Army Science Conference—a total of 257 authors and coauthors, who will be reporting on their work as in-house laboratory researchers.

The honor is the Dr. Paul Allman Siple Silver Medallion, initiated in 1970 to memorialize the U.S. Army's most famed Antarctic and cold regions explorer and scientist. His career was launched when he was selected from 82,000 Boy Scouts to accompany Admiral Richard E. Byrd on his first expedition to the Antarctic, 1928–30.

Dr. Siple's worldwide fame was gained as an explorer, but to countless associates in Army research and development he was eminently respected as a scientist—scientific adviser to the Director of Army Research when he died at his desk in 1968 at the age of 59.

Author of several books and numerous publications in scientific journals, Dr. Siple thought deeply about problems involving Army scientists and engineers—how to provide them with the optimum, and still practical, environment to stimulate creativity. The following was written in his capacity as Army Research Office member of a governmental Steering Committee for Development of Career Field Programs. Dated July 18, 1961, it is still substantially current to similar problems today.

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In the development of a career program for Army scientists and engineers, the Steering Committee suggests certain management policies and procedures for government personnel in these categories.

Scientists, engineers, and certain associated professional employes, usually come into civil service with a substantial pre-training investment. They hope to amortize this personal investment by qualifying for higher grades. They are expected to learn on the job and to apply their professional specialties to the needs of the Army. This procedure places them in a special relationship, differing from the mass of civilian employes with minor skills or no specialization before entering Civil Service.

Professional employes normally have a college education or its equivalent plus specialized training which may range from one to five or more years. The Army seeks to fill its professional jobs with qualified personnel possessing actual or potential superiority in their special fields. If the Army is to retain its professional employes and receive maximum productivity from them, it must recognize and foster their particular aims, ambitions and requirements.

Scientists, engineers, and other professionals choose a field of interest before they choose employment with the Army. Without questioning patriotic motives, it can be assumed in general that their primary interest lies in their field of specialty, and that civilian military employment is a secondary consideration. Therefore, particularly in the early years of service, they may be enticed away from their Army employment if they find a better means of pursuing their specialty.

Professional scientists and engineers are prone to place their desire to apply their profession effectively above salary considerations; i.e., many scientists and engineers in the most productive period of their lives become absorbed in their professional pursuits, to the extent that they minimize their own personal desires for comfort and an improved standard of living.

Scientists frequently prefer the cloistered academic life to that of higher salaried outside jobs, and often leave government employment with a cut in salary to return to work in an environment more conducive to pursuit of their profession.

In the fast-moving fields of science and engineering technology, professionals must keep abreast of new developments in their specialties. This requires extensive reading, frequent contact with colleagues in their profession and visits to centers of outstanding progress in their field.

Adequate maintenance of their proficiency attuned to the time cannot be achieved if the individuals endeavor to do this entirely on annual leave and off duty hours. As General Medaris so aptly stated:

"Engineering knowledge deteriorates in a vacuum. Any competent scientist or engineer will agree that if he is denied the responsibility for actual work, or the opportunity to do and see or to say how to do and thus test his own judgment, he will deteriorate. Eventually he will become the type of engineer who looks at someone's blue print and hopes he is right, but he is always haunted by a nagging doubt because his experience is not current."

Motivation of individual scientists and engineers is usually related to development of reputation and recognition within their fields of specialty. They would often rather be recognized for achievement than receive a promotion.

No individual, professional or not, is apt to shun salary improvement. This particular group of employes is prone to neglect nurturing other sources of possible income because of preoccupation with their work and, therefore, live entirely within their salary income. As their reputation grows, their obligations to meet public and special demands increase, so that they always need more than they make.

To achieve increasing professional reputation, the scientist especially needs to produce publications and requires time and encouragement to do so.

Pursuit of science and engineering presumes original thinking. Thinking is not exclusively dependent upon optimum environment for quiet introspection, but opportunity for seclusion is often essential. Overcrowding in laboratories or offices may seriously cut productivity.

Scientists and engineers of high productivity are prone to keep their minds close to an unsolved problem night and day. They often have periods of intensive drive. During these periods they have difficulty maintaining routine schedules. They may neglect other normal assignments and tend to adopt ir-regular working hours most effective to their own individual feeling of productivity.

Coworkers or supervisors, unmindful of this tendency, may misunderstand this behavior and consider such actions peculiar, or an idiosyncrasy. They may overweigh neglect of some routine assignment and underestimate the effort involved in all-out concentration on a problem.

Because of their specialization, scientists and engineers often come up with new ideas and inventions apparently not specifically related to their immediate assignment. If they are never given an opportunity to "prove out" these ideas, they may either get discouraged, and seek other employment, or their original thinking may dry up and even affect production of job-related new ideas.

A reasonable amount of time and assistance is needed to perform simple physical evaluation of their ideas as a measure of encouragement, respect for ideas, and stimulation.

Scientists and engineers can be most productive if they have adequate professional, sub-professional, and clerical assistance to perform their work. Their capacity to utilize assistance of other personnel will vary, but their potential productivity will suffer if the minimum requirements are not met.

Some scientists and engineers of highest technical skills may be poor at executing administrative functions. In addition, some lack the finesse in handling personnel and budgeting procedures. It is unfortunate when such individuals are pressed into administrative positions as the only means of advancement.

The Army has inadvertently lost superior professional personnel with great creative ability because they had to be removed from their positions due to a lack of administrative ability.

On the other hand, some scientists and engineers make excellent executives. Those that have talents and interests in the executive field should be given opportunity to advance along those lines. Much of the work at staff level, for example, is the management of scientific work rather than research itself.

If the best military-civilian teamwork is to be achieved, key positions must be given to the man best qualified, whether he be civilian or military. Nothing can kill incentive quicker than the idea that all unit chiefs in an organization must be either civilian or military.

HumRRO Completes SIAF Study With Delivery of Report to ARPA

The Human Resources Research Organization has completed a study of "Small Independent Action Forces" (SIAF) and has submitted a final report to the sponsor, the Advanced Research Projects Agency (ARPA).

SIAF was a 4-phase project. Phase I, completed in August 1970, involved orientation, systems and job analyses, and development of early training for SIAF personnel in identified critical areas.

Phase II, completed in July 1971, required the development of materials for the selection and training of SIAF personnel. Completed in December 1971, Phase III was an evaluation of personnel selection and of the training subsystem. Phase IV required the delivery of a final Technical Report on the selection and training of SIAF personnel.

AMRDL Research Contract Let For Ultrasonic Fuel Flowmeter

Research on a ultrasonic fule flowmeter without moving parts is expected to advance the Army's efforts to develop diagnostic equipment that will accurately determine the condition of aircraft engines.

Work on the flowmeter, which senses the speed of fuel flowing in a fuel line by noting the change of high frequency sound, is being done under an $88,000 research contract between the U.S. Army Air Mobility R&D Laboratory, Fort Eustis, Va., and Panametrics Corp., Waltham, Mass.

Advancement in Mine Technology . . .

Picatinny Arsenal's M66 Uses Seismic Detector

The M66 antitank mine, a second-generation off-route mine providing a horizontal effects capability against armored vehicles, has been introduced as a replacement for the M24 antitank mine.

Introduced in November 1965, the M24 mine utilizes a tape switch laid across the road traveled by a target vehicle. Actuation of the tape switch fires an M28 rocket (Bazooka round) at the target.

The tape switch was considered interimly acceptable, pending development of a fuzing system for an off-route mine with *nothing visible on the road.* The M66 with its M619 antitank mine fuze meets this requirement. Firing of a rocket requires two related events.

First, the vibration introduced into the ground by the target is sensed and identified as being uniquely associated with vehicles rather than nontargets. Seismic signals are detected by a geophone that converts mechanical motion caused by vehicle vibrations into electrical energy.

The second signal is generated upon interruption of an infrared beam by a target vehicle as it enters the boresight of the weapon. The infrared beam contains radiated energy outside the visible light spectrum in the near IR range.

The requirement for the two independent events to occur in sequence and within the same time period negates the probability of false firing. The leading edge of the target vehicle, blocking the infrared beam, causes the rocket to be fired at the target.

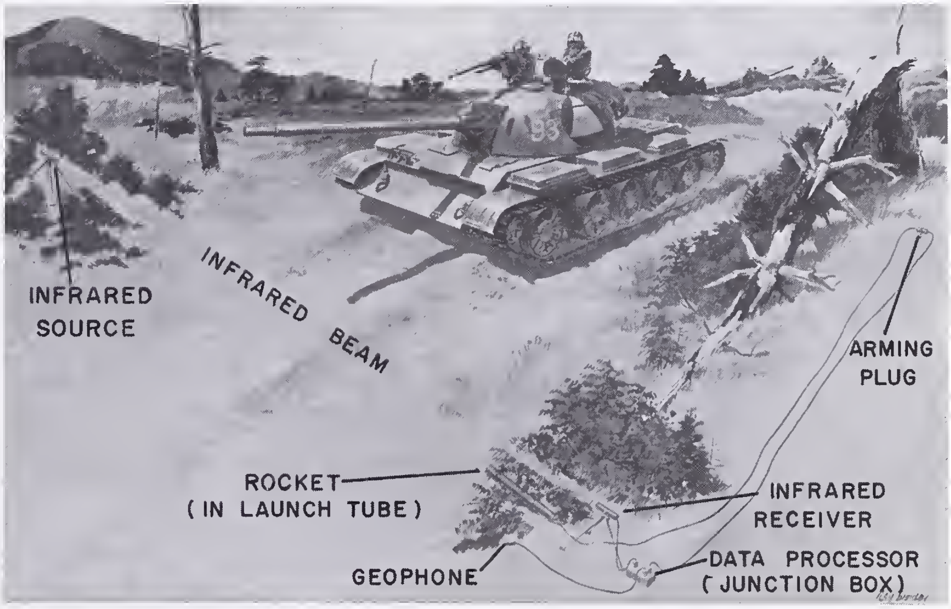
The M66 antitank mine can readily be set up in the field by one man. A typical emplacement is shown at right. The infrared source is battery powered and located on boresight with the receiver at the rocket emplacement site.

Alignment of the receiver and the transmitter is obtained by using sighting grooves located atop each of the two housings. The Geophone receiver is emplaced in the ground and its cable connects the data processor.

The processor contains batteries, serves as the junction box for the infrared and geophone signals, and provides the rocket firing energy through a cable.

Feasibility of the seismic-infrared concept was demonstrated at Picatinny Arsenal after extensive vibration signature studies on numerous types of vehicles. A commercially available infrared system used in conjunction with the seismic system design indicated that the concept was sound.

Development of the M66 antitank mine was conducted under the supervision of Richard M. Gutter, systems engineer, Ammunition Development and Engineering Directorate. The M619 fuze development, directed by Herbert I. Lewis, was supported under contract by the Santa Barbara Research Center, Goleta, Calif.



Homo sciens vs Homo sapiens . . .

Technology Leads to Conflict of Interests

By Dr. Robert J. Heaston

A species of man is dying out. In this modern technological age it is a paradox that *Homo sciens* is no longer a preferred species. His antagonist, *Homo sapiens,* is jealous of his preeminence.

This article is written in defense of *Homo sciens.* He is not guilty of all that has been attributed to him. We must keep *Homo sciens* alive and increasing in numbers. We cannot allow this species to disappear.

What kind of species is this man called *Homo sciens?* Let me explain. The recognized technical name for man is *Homo sapiens.* Man is the only living species of the genus Homo. The characteristic that has distinguished man from all the extinct members of the genus is sapience. It is surprising that this term is not used for any other purpose. What is this characteristic called sapience?

Sapience is derived from the past participle of the Latin *sapere* meaning "to know." It is to be contrasted with *scientis,* the past participle of *scire,* also meaning "to know." Yet, it is the latter form of knowing that appears the more dominant because *sciens* is the Latin root of "science." Why is man not called *Homo sciens?* Could it be that sapience is more important than science?

There is a difference between the two forms of knowing, sapience and science. The former is a mental form of knowing; the latter is a physical form of knowing. Sapience is a subjective form of wisdom. Science is an objective form of knowledge. The meanings of these two forms of knowing are as far apart as the dualism of mind and matter.

If there are such distinct differences, then there must be some species of the genus Homo that leans toward one form of knowing more than the other. People have always thought that scientists were a little different. They like things more than people, facts more than fiction, and phenomena more than passions. Such abnormal behavior must indicate a special species. These individuals belong to *Homo sciens.*

Homo sapiens can also be wise but in a different way. Sapience is a facetious form of wisdom. It is the kind of sagaciousness that is involved when we say that man is too smart for his own good.

On the other hand, man has been able to benefit from possessing sapience. Civilized society has grown under the impetus of sapience. Larger and larger population units have been created through the operation of this often divine wisdom. Alas, society has also suffered from a misguided sapience.

Both subjective *Homo sapiens* and objective *Homo sciens* have had to define a system of values in life. Values are needed in order to make decisions. Is this good? Is this true? Is this beautiful? The sapientific man finds his answers in the subjective nature of his own customs, traditions and beliefs. The scientific man looks only to nature and the objective repetition of order. Sometimes each borrows a little of the other in his judgment. If both are right, mankind has benefited. When either is wrong, history must be interpreted.

The time has come once again when one of the species is accused of making a mistake. This time, science is supposedly wrong. Look at what *Homo sciens* is doing to our world. He is polluting our rivers, our land, the very air all of us have to breathe. Our environment is being destroyed by technology. *Homo sciens* has created peaceful tools of unintentional destruction. It is just as obvious that the same species has created war-mongering weapons for deliberate devastation.

Science and technology have had such a terrible impact on society that we must study the roots of the matter. A name has been selected for this study. Scientology is the study of the effects of science upon society. The general conclusion of this study is that we must curb science, we must decrease research, we must halter technology.

Who has made all of these declarations against science? *Homo sapiens* decided the issues against *Homo sciens.* What a terrible distortion of means versus ends. Science is seldom wrong. *Homo sciens* usually make mistakes when it listens too much to *Homo sapiens.*

The real study we need is not scientology but sapienology. We want to know the *impact of society upon science,* rightly used science and wrongly used science. The real culprit is sapience. The wise man who thinks he knows science and makes a scientific decision is the one who is really guilty of ruining the environment. Why destroy the man who has produced the goods that you have misused? Enlist his aid to help you find a better way.

What is the relationship between society and science? The question should not be phrased the other way around. You should not ask how a tool relates to its manipulator? We are subjective beings living in an objective reality. If we do not like in subjective terms what we see, let us turn to the source that knows most about understanding and changing reality.

If, instead, we destroy those who have made things that have been wrongly wielded by our passions, then we have sapiently decided for our own demise. We will bury ourselves in an exponential proliferation of people who display more sapience than science.

In the future, *Homo sapiens* have no choice but to be more objective. Perhaps *Homo sciens* must also be a little more subjective. Both species must realize that the only hope is the proper use of sapienology.

Stop blaming scientists. There are too few of them to do all the harm that has been done. Look to greed, avarice, pride, pomp and power, all disguised as sapience in high and low places. Once again, man has cast his failings upon a minority scapegoat. Try to be a little more objective about the subjective side of life. Do not foresake *Homo sciens* in the struggle for a better world for everyone.

DR. ROBERT J. HEASTON was assigned to the Science and Technology Division, Office of the Chief of R&D, Department of the Army, when it was established Apr. 3, 1972. Assigned to the missile technology area, he is one of seven personnel responsible for overviewing R&D programs in special fields (See news article on page 10).

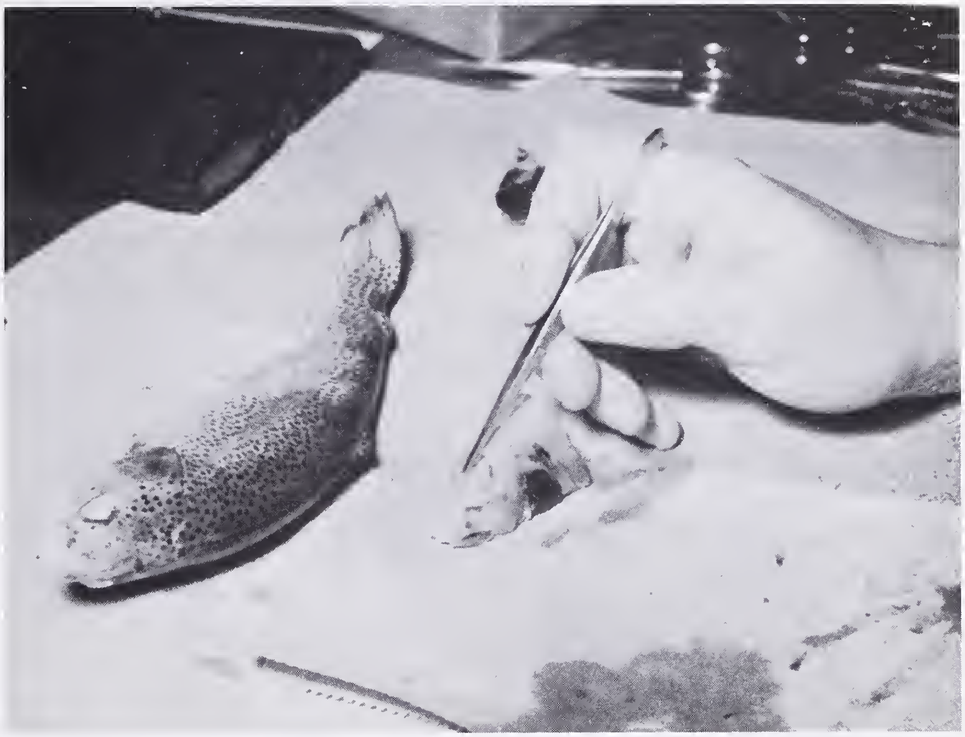
For the past two years, he was responsible for projects on pyrotechnics, propellants and explosives in the Physical and Engineering Sciences Division, U.S. Army Research Office, OCRD. From 1966 to 1970, he served with the European Research Office, in Frankfurt, Germany.

Prior to employment with OCRD in 1964, Dr. Heaston worked for the Advanced Research Projects Agency (1961–64) and the U.S. Air Force (1953–58). All his formal training has been in chemical engineering at the University of Arkansas and Ohio State University.

During the past 10 years, Dr. Heaston has developed a deep interest, as a hobby, in the philosophy of science and formulation of a unified theory of knowledge. He presented his systematic approach, which he calls "the trism theory," at the Third International Congress on the Logic Methodology and Philosophy of Science in Amsterdam (1967) and at the 14th International Congress on Philosophy in Vienna (1968). This article was derived from concepts presented in the earlier papers.

Pesticide Residues In Utah's Waters

By Paul R. Johnson



RAINBOW TROUT are dissected to determine acetylcholinesterase activity of the brain during research at the United States Army Deseret Test Center, Utah.

During the past decade the use of pesticides has been subject to a great deal of controversy. Recent investigations have provided evidence that the chlorinated hydrocarbons (DDT, Dieldrin, Methoxychlor, Toxaphene, Chlordane, Aldrin, etc.) pose a long-term hazard to the environment. Public reaction to this evidence has resulted in a decrease in their use.

In their place the organophosphorus compounds (Parathion, Malathion, Guthion, DDVP, Systox, etc.) have been deemed safer for wide-scale use as they decompose more rapidly in the environment. Thus they have played an ever-increasing role in pest control programs.

In 1970 alone, it is estimated that 182,101 pounds of organophosphates were used for agricultural, domestic, commercial and mosquito abatement programs in Utah, compared with 61, 918 pounds of chlorinated hydrocarbons.

However, while present evidence suggests that organophosphates break down more rapidly, they can still be dangerous to fish, birds and mammals, including man, when improperly used. Their mode of action is through the inactivation of acetylcholinesterase, which is an enzyme vital to the normal transmission of nerve impulses in animals.

Even when exposure is not serious enough to cause symptoms of poisoning, the presence of minute quantities of these pesticides can be detected by the reduction in acetylcholinesterase activity of the animals.

Biologists, therefore, are concerned that the use of organophosphates for agricultural, forest, domestic, commercial or aquatic pest control programs may possibly lead to exposure of fish, wildlife, livestock and perhaps man to undesirable chemicals.

Especially vulnerable to contamination is the aquatic environment. This can occur from careless applications, runoff from sprayed areas or, more significantly, through the dumping of unused organophosphorus compounds into convenient bodies of water, or direct application for the control of aquatic pest species such as mosquito and blackfly larvae.

More important, it has been shown that under certain conditions some of these compounds may retain their toxic properties for a longer period of time when they are in water. Therefore, an effective monitoring program can help to determine possible organophosphate contamination of the aquatic environment.

An ideal program would detect low levels of pesticides and prevent buildup to levels where fish kills may result, or wildlife and livestock which utilize the water as a drinking source could be endangered.

Personnel at the U.S. Army Deseret Test Center have initiated such a monitoring program. Minute quantities will inhibit the brain acetylcholinesterase activity of fish. Consequently, various local species of fish were considered to be convenient sentinels for aquatic contamination, instead of relying on chemical tests.

Use of a biological monitor has an added benefit, since any reduction in brain acetylcholinesterase activity will be detectable for prolonged intervals after exposure, it can indicate a potential hazard even after the toxic material has disappeared.

The rainbow trout has been chosen as a sentinel animal because of its wide distribution throughout the state and for its importance to Utah's sport fishery. The Fishery Section of the Utah Division of Wildlife Resources is assisting Army personnel by providing samples of rainbow trout for analysis.

Little background data could be found on brain acetylcholinesterase from cold water species of fish such as the rainbow trout. Therefore, initial efforts were directed toward defining the normal limits of brain acetylcholinesterase in various sizes of hatchery-reared trout—to establish baseline levels for this species.

Current investigations are concerned with varying water temperature under laboratory conditions to observe possible adjustments in brain acetylcholinesterase activity.

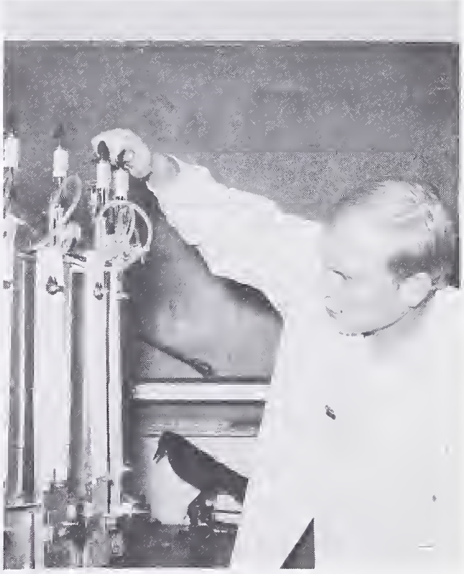
Investigations could next be directed to comparisons of acetylcholinesterase activity in hatchery-reared trout with those resident in the state's lakes and streams. Eventually, monitoring of Utah's waters could begin on a periodic basis.

In the event of suspected aquatic contamination in an area, upon request by state or local officials, Army personnel might well be able to assist in determining the presence, extent and perhaps the source of organophosphate contamination—before significant harm can come to wild animal populations, livestock or man.

Deseret Test Center hopes to play an increasing role in environmental protection, as well as in fulfilling its national defense mission.

When this article was written, the author, Paul R. Johnson, was enrolled in the Scientific and Engineering Program for Enlisted Men, working as a biological science assistant at Deseret (Utah) Test Center.

Following his discharge as a SP5 after serving a normal enlistment, he accepted a position in December 1971 with the Maine Department of Inland Fish and Game, and is stationed in Greenville. He has an AB degree in biology from Bowdoin (Maine) College.



The author, Paul Johnson, adjusts manometers on a Warburg apparatus used to determine acetylcholinesterase in rainbow trout.

Aircraft Materials Research . . .

Directed to improved composite materials for advanced military aircraft at AMMRC

By A. P. Levitt and E. Dicesare

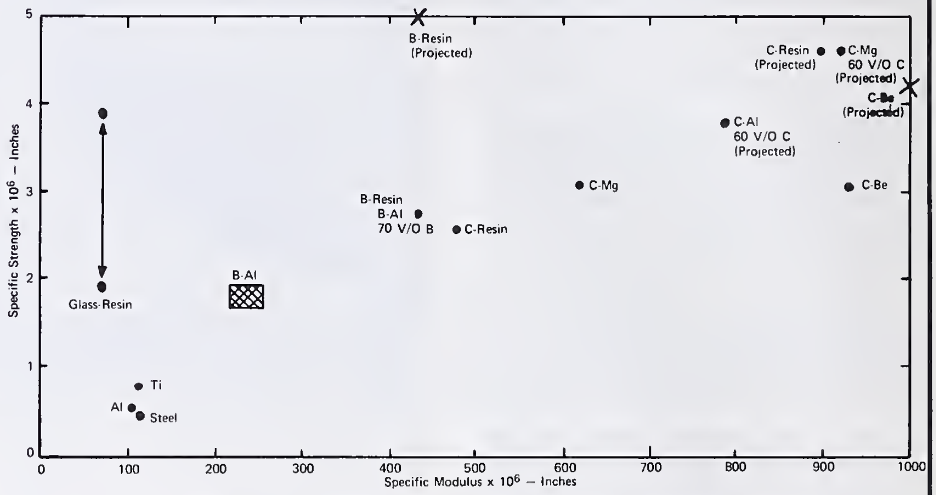


Fig. 1. Specific Mechanical Properties of Some Structural Materials

Research and development directed to improved composite materials for advanced military aircraft are of continuing high-priority concern to scientists and engineers at the Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass.

The specific stiffness (the ratio of elastic modulus to density) of magnesium is comparable to that of much stiffer engineering metals such as steel, titanium and aluminum because of its extremely low density (0.0628 lbs/in^3).

This characteristic together with its excellent castability makes magnesium the metal of choice for aircraft applications such as transmission housings where light weight and high section modulus are required.

Recent studies at Boeing Vertol have shown that, when the transmission system of the Chinook Helicopter (CH-47) is mounted in a massive ground-based housing having infinite stiffness, gear life can be significantly increased due to the virtual elimination of gear shaft deflections.

By reinforcing magnesium with advanced graphite fibers, the properties of this already useful engineering material can be greatly improved. Figure 1 shows that if all the criteria for reinforcement were met, this system would be superior in specific strength and modulus to all currently available resin- and metal-matrix systems.

Thus, the successful development of graphite-fiber-reinforced magnesium would yield, after fabrication, a lighter transmission housing whose increased stiffness would significantly reduce gear wear, extend gear life, and reduce helicopter down time. The Army Materials and Mechanics Research Center recently initiated a program to develop this composite system.

Liquid metal infiltration of the graphite fibers was selected as the fabrication method because the liquid magnesium can easily penetrate the mass of very small diameter graphite fibers (about 7.5 microns in size). Although large diameter fibers (about 2 millimeters in diameter) would be much easier to work with, there are none commercially available with the desired properties at this time.

Before a composite can be made, complete infiltration, wetting and bonding must be achieved between the magnesium matrix and the graphite fibers. This is necessary to permit load transfer from the weak, low-modulus magnesium matrix to the strong, high-modulus graphite fibers. This concept is illustrated in Figure 2, which plots the stress-strain curves in the elastic region for magnesium and graphite.

If we assume that the magnesium and graphite are bonded together so that when a load is applied to the composite both components strain equally, then the load will be distributed between those components as shown in Figure 2 with the high-modulus graphite fibers carrying the bulk of the load.

After initial experiments indicated that pure molten magnesium would not wet the graphite fibers, various metal coatings were considered for them as a means of promoting wetting. Several techniques were used to deposit nickel and titanium coatings on the small-

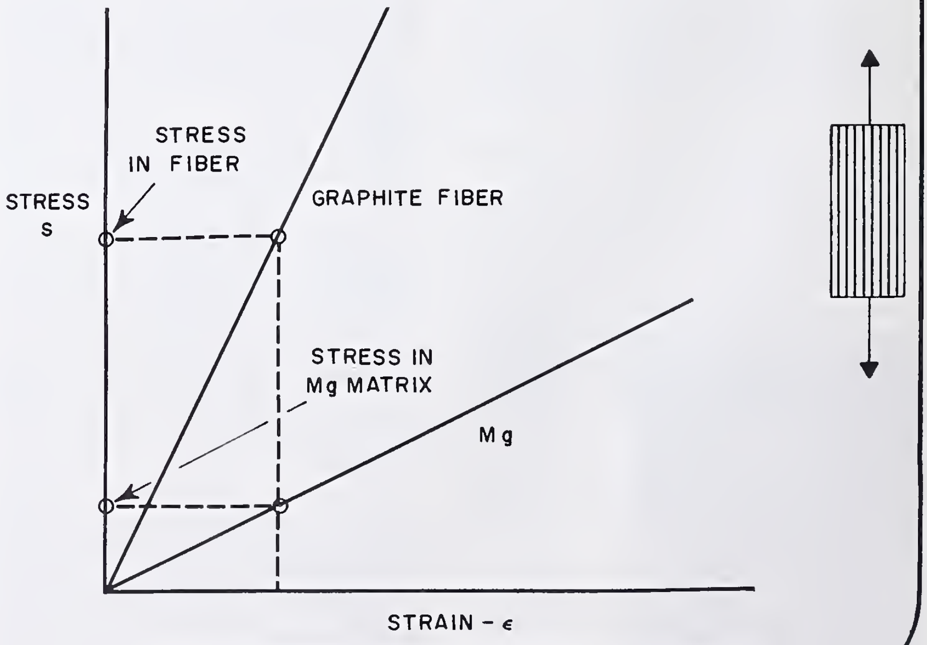


Fig. 2. Stress-Strain Curves for Magnesium and Graphite

diameter graphite fibers, which were then successfully wet and infiltrated with pure molten magnesium. The benefits of such coatings are illustrated in Figures 3 and 4.

Figure 3 shows a cross-section of a composite in which an attempt was made to infiltrate a bundle of uncoated Modmor Type I fibers (tensile strength = 250,000 psi, elastic modulus = 60 × 10^6 psi) with molten magnesium. Neither wetting nor penetration was obtained.

Figure 4 shows the fiber infiltration, wetting and bonding achieved with Modmor graphite fibers precoated with titanium. Similar results were obtained with nickel-coated graphite fibers.

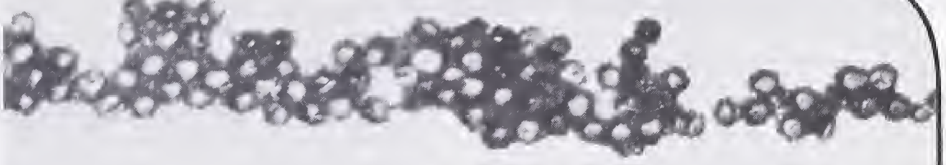


Fig. 3. Photomicrograph of Uncoated Modmor Filaments in Magnesium

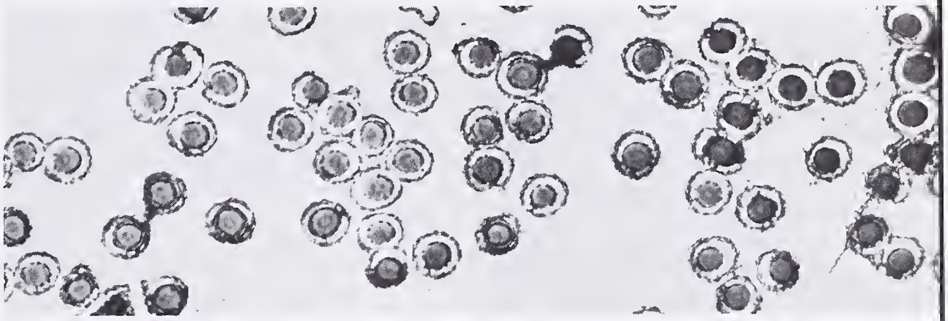


Fig. 4. Photomicrograph of Titanium-Coated Modmor Filaments in Magnesium

This development was then exploited by fabricating experimental magnesium graphite fiber composites, using a hot-pressing technique in which layers of aligned, coated fibers were infiltrated with pure, molten magnesium under pressure.

TABLE I

COMPOSITE PROPERTIES

Iden.	Volume % Mg	Volume % C	Volume % Ti	Tensile Str. Psi. Mech. Test	R.O.M. ‡	Yield Str. (.2%) Psi	Modulus - Psi X 10^6 Mech. Test	Ultra-sonic	R.O.M.	
HP 13	100	0		8160		4080				Load-Elongation
HP 15	100	0		9480		5385	3.4	6.9	6.5	Break @ Void
HP 10	69	11	20	19630	33,570	*	11.6	13.4	13.1	Break @ Inclusion
HP 16	71	10	19	25700	30,930	**	11.7		12.6	

‡ Rule of Mixtures
* No yield @19630 psi
** Slight yield @ 15200 psi

Pure magnesium was used initially in this study because it was readily available in powder form and because its use reduced the number of variables to be considered such as diffusion, interfacial reaction, and segregation of alloying elements.

Unreinforced magnesium specimens also were fabricated by this technique to provide a basis for comparing properties with those of the graphite reinforced Mg. All specimens had the dimensions 1½″ × 0.2″ × 0.05″, with integrally bonded, steel-gripping tabs 0.004″ thick for tension tests. Modulus of elasticity was measured mechanically and by an AMMRC-developed ultrasonic technique. Results are shown in Table I.

Although actual volume fraction of the fibers (not including their Ti coatings) was relatively low (about 10 percent), significant stiffening was achieved. The strength of the reinforced Mg was more than double that of the unreinforced metal and the modulus of elasticity was approximately doubled. These results are illustrated in Figure 5.

In these early specimens, the highest composite strength was 83 percent of the theoretical values predicted by the Rule of Mixtures. AMMRC researchers believe that by reducing composite porosity and improving fiber alignment, strengths approximating Rule of Mixtures strengths will be achieved.

Future studies will be aimed at fabricating fully dense composites having a high-volume fraction of completely aligned graphite fibers in Mg alloy matrix. Such a material would permit the fabrication of lighter, stronger and stiffer transmission housings for Army helicopters.

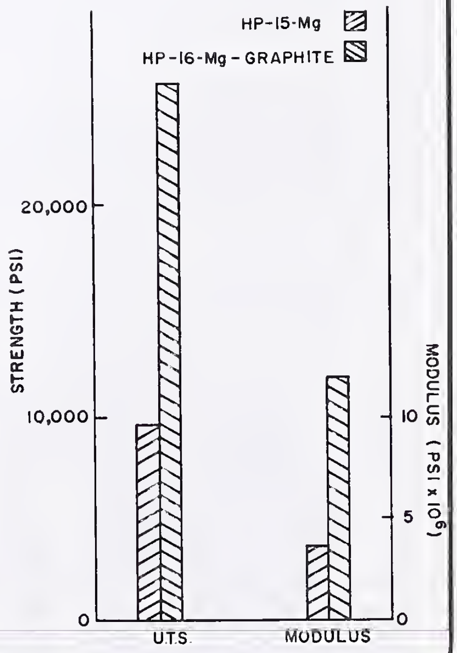


Fig. 5. Comparison of Mechanical Properties

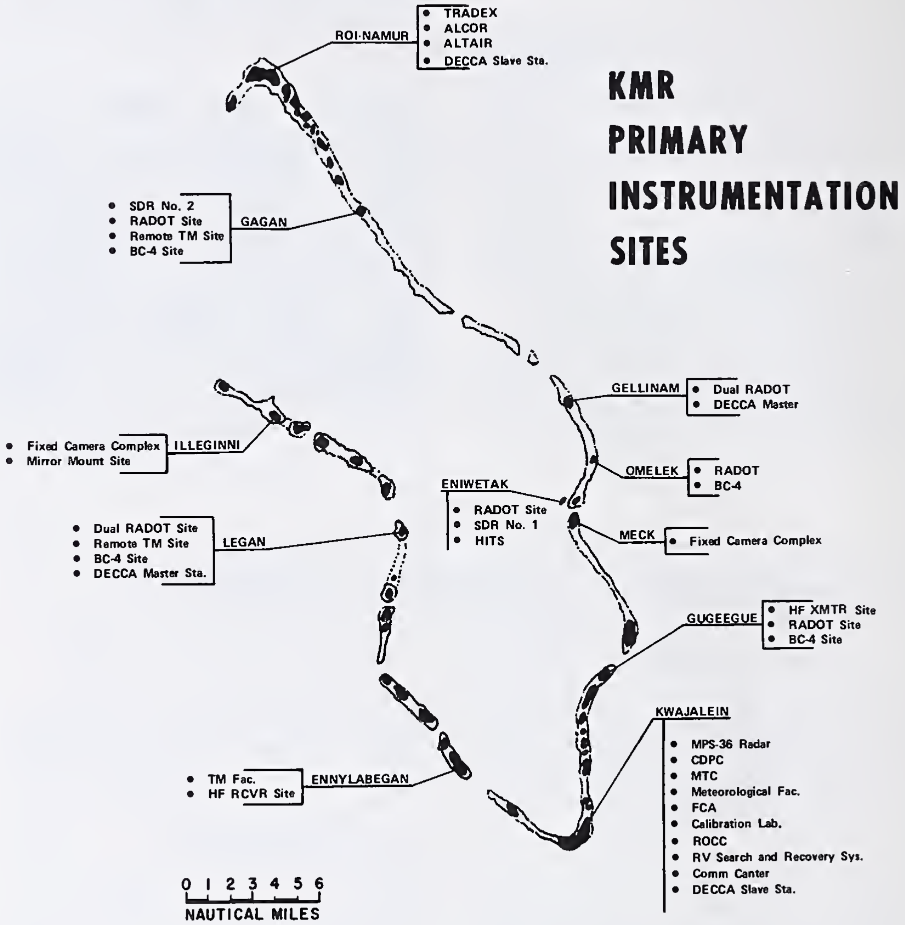
Albert P. Levitt (left) . . . AB degree in engineering sciences, MS in mechanical engineering, Harvard University; 1961 recipient of Army R&D Achievement Award; supervisor, Metal Matrix Composites Group at AMMRC.

Eugene Di Cesare (right) . . . BS in mechanical engineering, University of Massachusetts; employed as mechanical engineer at AMMRC (formerly Watertown Arsenal) since 1951.

Kwajalein Missile Range . . .

Safeguard Systems Command directs critical test program at Pacific atoll to measure weapon systems performance

By MAJ Dale R. Gramley
and
Robert L. Eison



KMR PRIMARY INSTRUMENTATION SITES

. . . Three . . . Two . . . One . . . Fire! A Minuteman missile blasts from its underground launch silo at Vandenberg (Calif.) Air Force Base, the West Coast launch site for testing ICBMs destination is a preselected point at the U.S. Army's Kwajalein Missile Range in the mid-Pacific Ocean.

One of five national ranges maintained by the U.S. Government for weapon system testing, the KMR is located in the Marshall Islands on Kwajalein Atoll.

Approximately 2,100 miles southwest of Honolulu and 5,000 miles southwest of Vandenberg AFB, the atoll is composed of approximately 100 small islands with a total land area of only 5.6 square miles. The U.S. Government has land use agreements for 15 of these islands on which the range conducts its activities.

Kwajalein Atoll surrounds the world's largest lagoon, 902 square miles, which has an average depth of 180 feet—compared to ocean depths of a mile and more offshore. Because of the size of the lagoon, depth of water, location and sophisticated radar, optical and telemetry systems, the KMR is termed "uniquely suited" for testing long-range ballistic missiles, for basic research into reentry physics phenomena, and for the development of the radars and missiles of the Safeguard Ballistic Missile Defense System.

The National Range Commander, who has a dual responsibility as commanding general of the U.S. Army Safeguard System Command, is located in Huntsville, Ala. The Kwajalein Missile Range Directorate, an organization within this command, is charged with planning, managing and controlling the KMR operation.

Army, Air Force and Navy programs at the KMR must be documented several years in advance of actual missions to allow for planning, funding and procurement of resources and facilities. Subsequently, prior to a test firing, months of planning, coordination and facility preparedness are required.

After a missile is launched, area and mid-course area data collection is accomplished by Air Force and Navy sensors. As the ICBM with its reentry vehicle (or vehicles) emerges over the radio horizon, KMR sensors initiate data collection.

Kiernan Reentry Measurements Site (KREMS) sensors, composed primarily of the ALTAIR (ARPA Long-Range Tracking and Instrumentation Radar), ALCOR (ARPA Lincoln C-band Observables Radar) and TRADEX (Target Resolution and Discrimination Experiment) radars on the island of Roi-Namur (see Figure 1), begin the complex task of collecting electromagnetic signature data.

Data collected are used in the study of the physical interaction between reentry vehicles and atmospheric environment. The data are important in the research, development, test and evaluation of offensive and defensive weapon systems.

The ALTAIR system was designed and developed to gather coherent data on ballistic and orbital vehicles at very high and ultra-high frequencies. Peak power of 10 megawatts at VHF and 20 megawatts at UHF is radiated by a 150-foot diameter antenna.

The ALCOR is a high-power, narrow-beam, coherent chirped C-band tracking radar, capable of switching rapidly from target to target during a given operation. Peak power of four megawatts is radiated by a 40-foot diameter antenna.

The TRADEX radar is a coherent system capable of tracking one target in angle and range or five targets in range only simultaneously. The radar generates a 4-megawatt peak power signal radiated by an 84-foot antenna.

In addition to the KREMS sensors, the AN/MPS-36 radars on Kwajalein collect metric data from acquisition at radio horizon to re-entry vehicle (RV) impact. They are coherent C-band radars that transmit 1-megawatt peak power signals to 12-foot diameter antennas. Because of the relative low transmitter powers and small-size antennas, these are primarily beacon tracking radars and as such are the primary metric tracking radars at the KMR.

As the reentry vehicle or vehicles continue their journey to the KMR, S-band telemetry systems on Ennylabegan, Legan and Gagan Islands begin collecting data. The regions of interest for telemetry data collection are often during and after the RVs re-enter the atmosphere. The main KMR telemetry complex at Ennylabegan has a 28-foot, a 24-foot and four 10-foot diameter autotracking antenna systems to receive telemetry signals.

Signals are combined, demultiplexed, and data are recorded (in analog or digital formats) for display in analog or digital printout form. A computer-operated antenna acquisition buss allows rapid switching of antennas to different targets, by way of slave signals from other telemetry antennas or radars on other islands. Remote telemetry receive/record stations on Legan and Gagan support primarily the Safeguard System launches at the KMR.

After the RVs re-enter the atmosphere, the glowing targets allow the collection of optical data by two KMR optical sensor systems—ballistic cameras and RADOTs (Recording Automatic Digital Optical Trackers).

Modified BC-4 ballistic cameras on the islands of Gugeegue, Legan, Omelek and Gagan have an intricate rotating shutter system. This "chops" the received light from the targets and allows the photography of position data as a function of time.

Although RADOTs are utilized primarily to provide metric and engineering sequential data of Safeguard, Spartan and Sprint launches in the Kwajalein Atoll, they are also utilized to collect metric data on RVs. These systems are cinesextant trackers utilizing 35 or 70mm cameras with frame rates up to 2,500 frames per second. Metric accuracies with RADOT are typically ±15 feet at 100,000 feet slant range.

If the RVs impact inside the Kwajalein Lagoon, other KMR sensors determine the impact location and time of impact. Two Ka band (34-35 GHz) Splash Detection Radars (SDR) are located on the islands of Eniwetak and Gagan. These radars feature rotating back to back dishes atop 110-foot-high towers and detect the water plumes created by the impacting RVs.

Each radar has a scoring radius of 20 NM with an accuracy of ±50 feet. Time of impact is measured by a Hydroacoustic Impact Timing System (HITS), composed of a hydrophone system and associated receiving and recording equipment on Eniwetak Island. Current time of impact accuracies are ±130 milliseconds but future improvements will improve that value to ±15 milliseconds.

All RVs impacting within the lagoon are recovered. Scuba divers and a 2-man submarine aided by impact location data search for and recover payloads or other impacting objects of interest.

Various other facilities and systems support KMR missions. Communications from the KMR to other Pacific area stations is performed at high frequencies. All HF long-haul transmitters and transmitting antennas are on Gugeegue Island while receivers and receiving antennas are on Ennylabegan Island.

Intra-atoll communications are accomplished primarily by a network of submarine cables connecting all major islands. Voice and digital data between key sensors are passed by this cable network. Communication with the CONUS is primarily accomplished by satellite.

The KMR SCT-21 terminal on Kwajalein allows communication via Defense Satellite Communication System satellites by voice, teletype and data transmission and reception. The SCT-21 has a 21-foot diameter antenna and operates in the X-band.

Among systems and facilities that have important support roles are:

- An AN/FPS-41 weather radar and meteorological rockets and meteorological data gathering equipment.
- A Master Timing Center (MTC) that distributes accurate timing to all instrumentation sites and utilizes cesium-beam clocks kept to within +1 microsecond or better of U.S. Naval Observatory (Department of Defense Master Clock) by use of a unique communications satellite time closure technique.
- An electronic countdown system that provides accurate digital countdown data at all instrumentation sites.
- A Frequency Control and Analysis (FCA) facility that electronically scans the RF spectrum from 2 MHz to 12 GHz 15 times a second in search of potential radio frequency interference sources.

Range Operations Control Center (ROCC) where command and control of all KMR support is performed.

- A Central Data Processing Center (CDPC) for the data handling and processing of business and scientific tasks.
- A DECCA Hi-Fix positioning system utilized to position instrumentation ships and other water vessels involved in marine operations.

Because of the diversity of the sensors within the KMR, and problems in acquiring and/or tracking targets during launches or reentry, a Data Acquisition Systems has been developed at the KMR. This allows the transmission of "pointing" data between KREMS and MPS-36 radars and from these radars to telemetry antenna systems and RADOT.

Data are passed via the submarine cable network and are processed by on-site computers and the Kwajalein-based CDPC. This system allows the slaving of the passive sensors (RADOT and telemetry antennas) by radars over an entire mission.

The KMR is also the site for the test and evaluation of components of the Safeguard Ballistic Missile Defense Sys-

(Continued on page 26)

MAJ DALE R. GRAMLEY is assigned to HQ U.S. Air Force (USAF) on the staff of the director, Kwajalein Missile Range Directorate, U.S. Army Safeguard System Command, Huntsville, Ala.

Commissioned in the USAF upon graduation from the U.S. Naval Academy in 1954, he entered missile training at Lowry AFB, Colo. His first assignment was with a tactical missile organization as a launch officer, followed by duty as a maintenance officer, and then as chief of calibration and target data units.

After a 3-year tour of duty in Germany, he earned a master's degree in astronautical and aeronautical engineering from the University of Michigan in 1961. Then he served in the Minuteman System Program Office of the Space and Missile Systems Organization, Norton AFB, Calif., and at Air Force Systems Command HQ, Andrews AFB, Md.

MAJ Gramley has completed, by correspondence, the Industrial College of the Armed Forces National Security Management course, the AF Air Command and Staff College course, and the Squadron Officer School course.

ROBERT L. EISON joined the Kwajalein Missile Range Directorate in 1967, with responsibilities in development of telemetry, timing, countdown and frequency surveillance systems at the range. Since early 1971, he has managed an instrumentation system accuracy evaluation and improvement program.

Eison earned a BSEE degree from Vanderbilt University in 1960, subsequent to employment by the U.S. Naval Missile Center, Point Mugu, Calif. In 1963, he joined the NASA Lewis Research Center in Cleveland, Ohio, where he performed systems design on spacecraft instrumentation systems.

Later that year, he joined the Pacific Missile Range at Point Mugu, where he served as a consultant to the Defense Atomic Support Agency for development of S-band telemetry systems, and as a member of the Joint Task Force Eight Frequency Management Group.

Kwajalein Range . . .

(Continued from page 25)

tem, including the Missile Site Radar (MSR) and the Spartan and Sprint interceptor missiles. Launching of these missiles from Meck and Illeginni Islands is supported by the same radar, telemetry and optical instrumentation systems that support RV missions.

In addition, 35- and 70mm fixed cameras located around the Meck launch site provide engineering sequential and metric data during the first 1,000 feet of missile altitude. KMR radar and optical systems provide miss-distance measurements on Spartan and Sprint intercepts of RVs.

After the completion of a mission at the KMR, data must be delivered to the Range User in accordance with a predetermined data interchange plan. Literally miles of radar data, telemetry tapes and photographic film may be used to record information during a single mission. The majority of the data are carefully labeled, packaged and returned to stateside data reduction facilities for processing, and then delivered to the range user for analysis and publication.

Approximately 5,000 U.S. citizens reside at KMR, consisting of about 2,000 dependents, 100 military, 100 civil service employes and 2,800 contractor personnel.

Since technical facilities are located on 12 different islands, fixed-wing aircraft (Caribou and C-54) are used to ferry personnel between Kwajalein, Meck and Roi-Namur Islands, which have suitable landing strips; and either helicopters (UH-1H) or water taxi to the remaining islands. Intra-island transportation consists of a limited number of government vehicles or bicycles. No private automobiles are allowed.

KMR provides housing (BOQs, trailers and single and multiple dwellings), a hospital, commissary, PX, bank, barber and beauty shops, chapel, schools (elementary, junior-senior high school), and clubs.

Offsetting the lack of TV are such leisure activities as boating, bowling, fishing, golf, ham radio, hobby shop, baseball, library, movies, shelling, snorkeling, scuba diving, swimming, football, basketball, tennis, volleyball, softball, soccer and "mountainball." A flying club is available at which one can receive instructions or check out a small plane for flying in the local area.

Kwajalein Missile Range is vitally important to the Department of Defense because it is the only test area where offensive and defensive missile weapon system encounters can be simulated in a tactical environment—making its successful operation fundamental to the over-all national security.

Small Arms Agency Innovates Policy for 'Coupling'

Innovation, in the form of positive action to impose upon contractors a requirement to insure adequate "coupling" of new technology, is built into plans to initiate development of a small arms weapons system.

A first step in this direction is exposure of commercial/industrial personnel to the new technology developed under the Army Small Arms Program.

COL Raymond S. Isenson, commander of the U.S. Army Small Arms Systems Agency at Aberdeen (Md.) Proving Ground, is planning a "Seminar on Small Arms Technology" in May. The purpose is to expose prospective contractors to "our newly gained knowledge and to identify for them the points and persons of expertise within the Army."

As explained by COL Isenson, "The rationale . . . is that would-be contractors will have had time to select their key engineers but probably will not have proceeded very far into the preparation of proposals.

"Hopefully, the presentations will influence positively these key engineers in the technical choices and quality of the proposals. This planned seminar is not intended as an alternative to the normal pre-bid conference, nor is it desired that the presentations conflict in any way with the normal process of any pending bid or proposal."

COL Isenson's background for this type of innovation is extensive, starting with an assignment in 1962 as chief of the Research Plans Office, Office of the Chief of Research and Development, Department of the Army.

While on this assignment he developed the first long-range technological forecast that encompassed all scientific and technical areas of known interest to the Army. He also produced a concept for and developed the first Army-wide research plan.

COL Isenson's next assignment was director, Research Effectiveness Studies, Office of the Director of Defense Research and Engineering, where he gained international recognition for his work on technology transfer, the sociology of technology, and R&D management. He was credited with a key role in Project Hindsight, an intensive and long-duration study of basic research and exploratory development patterns in modern weapon systems.

AUTOSTRAD Enables Army To Cut Transportation Costs

Transmitting military transportation data through the Defense Communications System enabled the Army to save taxpayers $4.4 million last year in moving personal property of military families to new duty stations.

The automated system for transportation data (AUTOSTRAD) is comprised of six major functional systems: passenger traffic management system (PASTRAM), freight automated system (FAST), terminal management system (TERMS), worldwide household goods information system (WHIST), mobility planning data system (MODS), and command and administrative data system (COADS).

Under the U.S. Army Strategic Communications Command (STRATCOM) Communications Agency and the military Traffic Management and Terminal Service (MTMTS), these systems and their effectiveness rely on top priority attention to advancements in the communications field.

The STRATCOM Communications-Agency-MTMTS team will be the first in the Army to use the futuristic automated telecommunications center in the first phase of ATCAP (Army telecommunications automation program). While Army-wide use of ATCAP systems is not expected before 1980, installation of the first phase in Oakland, Calif., is scheduled for completion in 1973.

COL Ladson Receives German Order of Merit

On behalf of the President of the Federal Republic of Germany, the German consul general to New Orleans recently presented the German Order of Merit, First Class, to COL Robert N. Ladson.

The award honors COL Ladson for his efforts while he formerly commanded the U.S. Army Chemical Center and School at Fort McClellan, Ala. Consul General Frau Dr. Hannelore Theurer said that the honor was conferred on COL Ladson for his "friendly understanding and close collaboration" with her government's liaison officers and with German officers studying at the Chemical School.

Dr. Theurer said this cooperation has enabled the Germans to develop defensive capabilities against chemical, biological and nuclear weaponry.

The German liaison officer at the school, LTC (Dr.) Heinz J. A. Hofman (shown at left of photo), pointed out that the German Order of Merit is known to have been presented to only one other U.S. Army officer in the United States.

During his 26-year career as a Chemical Corps officer, COL Ladson has taken advanced and command-level training and assignments in intelligence and in chemical, biological and radiological warfare. His tour as commandant of the Chemical Center and School, his third at Fort McClellan, preceded his current assignment at Fort Sheridan, Ill.

MERDC Demonstrates Integrated Transistor Switch

By Eberhart Reimers

Feasibility of a new electrical switch, considered usable for a wide range of military power systems applications, has been demonstrated by the Electrotechnology Department of the U.S. Army Mobility Equipment Research and Development Center (MERDC), Fort Belvoir, Va.

Identified as the Integrated Hybrid Transistor Switch or IHTS, it utilizes state-of-the art discrete power transistors combined with novel control circuit and electronic packaging techniques, permitting modular construction of electrical power conditioners within a power range of 5 to 40 KVA.

The need for the IHTS was recognized at MERDC more than three years ago because transistors have essentially ideal switching operating characteristics when compared with thyristors.

Unfortunately, transistors are "soft" devices, unable to withstand instantaneous current overloads. This is a need generally dictated by circuit and power systems requirements for Army-type power conditioning equipment.

Another limitation is a consequence of the transistor being a linear device having a low current gain which in turn requires a sustained base drive when switched on.

Furthermore, transistor wafer construction yields typically one-tenth the current density of thyristors. This low power density when switching, and the ensuing control circuit power needs, precluded the cost-effective design of medium and large power conditioners for land mobile applications.

Cost effectiveness of equipment design, however, cannot be solely judged on the cost-performance capability of the solid-state power switch. Rather, it must be evaluated within the context of the entire equipment support needs. These needs have been significantly reduced by breaking with past circuit control and packaging methods, yielding a low-cost power transistor switching concept.

The concept makes full use of the device's ideal operating switching characteristics without being susceptible, like transistors, to damaging overload current transients.

In view of the cost requirement of thyristorized dc link power conditioners, the IHTS was conceived in-house at the MERDC and bread-boarded with discrete components comprising low-voltage power transistors.

After proof of feasibility, and the evaluation of the potential economics of the controls and dynamics of multiple paralleling of power chips, a contract was let with the Texas Instrument Co., Semi-conductor Division, Dallas, Tex. Industrial design know-how was applied to the construction of economically feasible hardware.

Each IHTS contains two electrically isolated high-power transistor switches within one enclosure. Individual base drives are electrically isolated from the output. Both power stages are independently controllable or can be synchronized with an internal "blanking inhibit" control.

Each half-section is protected against the following failure modes: thermal breakdown, short-circuit current, line-to-line shoot-through, auxiliary supply voltage failure, excessive dv/dt and single-pulse over-voltage transient.

The IHTS must be externally protected against failure modes such as repetitive pulse over-voltage transient and excessive di/dt when operating in the short-circuit current mode.

As applicable, discrete component assembly and printed circuitry or thick-film substrates have been utilized to achieve the high package and power density within the IHTS. The entire electronic packaging effort has been directed toward ease of assembly, maintenance and field servicing capability of the module. Thus, each subassembly is fully self-contained and replaceable.

Maximum heat conduction has been maintained by making the heat sink an integral part of the switch. Since forced air-cooling is envisioned, a heat-sink design was chosen for maximum air flow turbulence.

The IHTS has been designed in a low-and high-voltage version to satisfy most U.S. Army and other government needs. The present versions operate from 23- to 29-volt battery/dc-generator power supplies and from 200 to 330 dc volt power supply systems. It should be noted, however, that the IHTS can be modified to operate efficiently from extra-low-voltage power supplies.

Each half-section operates in either a stable "off" or "on" state and is controllable by a 2- to 5-volt, 2-milliampere input amplitude corresponding to transistor-transistor logic (TTL) or diode-transistor logic (DTL) requirements. External provisions have been made for enabling or disabling the blanking inhibit.

Preliminary testing of the IHTS at USAMERDC has demonstrated the device's capability to switch 20 KVA sustained peak power. This corresponds to typically 5 to 10 KVA power switching capability when operating as part of a land mobile power conditioner system.

Development of the IHTS provides new alternatives to the Army in the area of high KVA per pound of power conversion equipment. The new concept makes possible modular construction of direct current and alternating current power converters for precision and electrical propulsion applications; regulated power supplies; high-frequency pulsactors for Klystron and laser beam applications; programable voltage/frequency power supplies; deep submergence and aerospace applications, and others.

This gives rise to the expectation that the cost of the IHTS can be significantly reduced due to its potential universal utility in equipment and the resulting simplicity of constructing power conditioners.

Under a recent second-generation contract for production, the IHTS will have an improved switching capability and will be hardened in terms of thermal and mechanical shock, moisture, vibration fatigue, steady-state operating life and power cycling.

A detailed evaluation of the first-generation IHTS is being conducted by the MERDC Electrical Equipment Division in terms of equipment design.

Eberhart Reimers is a research electrical engineer in the Electrical Equipment Division, Electrotechnology Department, U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

Born and educated in Germany, Reimers joined the R&D Center in 1967. Since then, he has received a number of Special Act or Service Awards for authoring technical papers; a Sustained Superior Performance Award; and four initial awards for inventions for which patents are pending.

'Information Base for Reading'

Certain Army-sponsored research conducted by the Human Resources Research Organization (HumRRO) is published by the U.S. Office of Education in one of its major reports, "The Information Base for Reading."

Provided under the "targeted reading program," this report serves as a means of letting civilian educators know about some of the U.S. Army's research activities.

Technology Assessment . . .

Aroused public demanding knowledgeable answers to the impact of technology on the quality of life

By Harold Davidson

HAROLD F. DAVIDSON is employed as a physical scientist with the Science and Technology Division, Office, Chief of Research and Development (OCRD), specializing in science policy, technology transfer and technology assessment and their effects on the Army.

Prior to employment with OCRD in 1963, Davidson was involved in research and development in the materials sciences with the Bureau of Ships during World War II (except for Naval service during 1944–45), the War Assets Administration, and the Material Laboratory at the New York Naval Shipyard.

He also was engaged in nonmetallic materials research with the Bureau of Ordnance, which later became the Bureau of Naval Weapons, Navy Department.

A native of New York City, he graduated from the College of the City of New York in 1940 with a BS degree in chemistry. He later earned a master's degree in chemistry from Brooklyn Polytechnic Institute and a master's in management from the George Washington University. He is a member of the American Association for the Advancement of Science, The American Society for Testing and Materials, and The Society of Automotive Engineers.

Within the past five years a pronounced movement away from our traditional unquestioning acceptance of new technology has taken place. We are now seeing a better informed, technically literate public, including Congress, taking part in a debate over the social effects of technology.

The scientific community is questioning the expected uses of its discoveries, and there is a general reluctance to accept new technology without an analysis and discussion of its effect on the environment, consumers, labor, future generations, etc.

Reinforcing this trend is the increasing rate of complexity, the global scale of effects, and the increasingly complicated by-products of modern technology.

All these influencing factors have led to a demand for more thorough, systematic analysis of technological advances, with attention to social as well as economic effects. This process has come to be called *Technology Assessment* (TA). Environmental impact statements are a good example of TA.

From a corporate point of view, these emerging trends mean a continued narrowing of the range within which corporate management can make decisions. During the past 25 years a network of economic constraints has been developed to limit the effects of a "laissez-faire" economic system.

With the notable exception of the U.S. Food and Drug Administration and the Atomic Energy Commission, there have been few governmental or societal limits placed upon the invention and exploitation of new technology. The future, however, will see more constraints on technology, similar to the web of economic legislation which led to establishment of the Securities and Exchange Commission, the Internal Revenue Service, the Federal Trade Commission and other regulatory bodies.

The end of what might be called the "Age of Laissez-Faire Technology" is fast approaching. The legislative and administrative trend is slowly becoming clear, following passage of the Environmental Protection Act along with a steady stream of bills to create a technology assessment capability for the Congress.

What this means for industry and the Army appears obvious: While decisions among technological alternatives (both R&D and manufacturing) have traditionally been made on the basis of probability of technical success, and potential profitability of a technically successful result, a new factor is in the offing—TA.

If the trend toward consideration of the social and environmental effects of technological developments matures, then both industry and Army decision-makers will have to add a third decision influencing criterion—potential/probable adverse social and/or environmental effects, i.e., second- and higher-order consequences.

Second- or higher-order consequences basically are those side effects that arise from a technological development. For example, the supersonic transport (SST) was to be developed by the United States for high-speed travel, but a second-order consequence—pollution ostensibly, among others—killed it.

This means that the traditional R&D (and production) project evaluation and selection processes will have to be revised to allow and accept evaluation of possible adverse social and/or environmental effects.

Technology assessment studies will have to be performed to establish the second-or higher-order social effects, along with the technical and economic studies which establish the probability of technical success, and potential profitability.

In considering new problems TA will undoubtedly generate, numerous factors will need to be considered:

- The military services all use project evaluation and selection systems similar to those of industry. In most cases the military system is more advanced. A Congressional requirement to consider the criterion of social and environmental effects would require a revision of the project budgeting mechanics and a vast amount of new input data.
- Establishing the second- or higher-order social and environmental effects of a proposed new product or process is an order of magnitude more complex than the development of technical and commercial success probabilities. A large number of individuals will need to be taught the basics of technology assessment, but this should not be a difficult project.
- Possibly the Army will have to enforce a TA requirement in procurement, and in research, development, test and evaluation (RDT&E) contracts.
- "Interested" outsiders (Congress, the National Academy of Science, university professors, public interest groups) may undertake assessments of military and/or military related technology, on either an invited or an uninvited basis, which will have impacts on the development of military technology.

Technology assessment is now coming into use as a problem-identification tool for national science policy, especially at the National Science Foundation. The Office of Science and Technology, Executive Office of the President, recently completed a study looking to "the development of an analytical framework and a structured procedure (methodology) that could be used for anticipating the societal impact of major technologies."

If these considerations affect research and development funding, especially in the basic sciences, the scientific base from which new military capability is developed may be affected in the long run. The Army will need to understand the process in order to have a creditable input.

Examples of problem areas within the Army which could benefit from studies using the methodology of technology assessment include: The impact of covert weaponry such as antiaggression aerosols, weather modification, the chemical, biological and radiological (CBR) effects of weaponry and the effects of munitions plants effluents.

Additional study areas meriting consideration are environmental issues in a peacetime Army, such as nonpolluting vehicles; impact of drug addiction and treatment methods on returning troops and society; solid-waste disposal; munitions disposal; and the impact of behavioral research on individual rights of privacy.

Some parts of the Army, such as the Corps of Engineers, could become deeply involved in technology assessment—especially as it relates to environmenttal quality and power generation problems. Many Army elements already are becoming increasingly involved.

Some positive TA aspects could aid the Army in maintaining a socially relevant position in a peacetime society. For example, the Department of Defense is the nation's largest RDT&E organization, largest purchaser of a wide variety of items, and largest user of a similar variety of items in the world.

The testing and use data of consumer products used by the Army, and evaluated for its own purpose, could be made available to the public. This has recently been done for a list of items procured by the General Services Administration. Army RDT&E labs, such as those at Natick, which conduct R&D on food and clothing items, could be used to perform work in line with consumer protection and product safety trends, without impairing military efficiency but earning recognition of the civilian economy.

Environmental quality, construction methods, transportation systems and power generation are all areas of technology in which the Army could make a positive contribution to the civilian sector as a performer of technology assessments and related RDT&E.

For example, the laboratories and test facilities at the Aberdeen R&D Center, could be used for a wide variety of technological assessments under contract to other government agencies.

An indication of the importance of an early development of at least a minimum level of understanding of technology assessment within the Army is contained in a section titled "Military Technology" in *Technology: Processes of Assessment and Choice* (Report of the National Academy of Sciences, available through the U.S. Government Printing Office). It states, in part:

"One would wish to incorporate more institutionalized criticism into the decision-making process for military technology—criticism designed deliberately to broaden the criteria of Technology Assessment well beyond the strictly military context. Unless this is done, there is real danger either of great social or environmental damage, or, conversely, of a broad public reaction against all forms of military technology, which might endanger the security position of the U.S."

A second bit of evidence supporting the need for understanding as a prelude to a capability for performing technology assessment is contained in a document titled, *A Technology Assessment System for the Executive Branch* (report of the National Academy of Public Administration, July 1970, available from the U.S. Government Printing Office).

In its "Summary of Panel Recommendations," the report lists the following in first place:

"Technology assessment should be made a continuing responsibility of each Executive Department and Agency and should be integrated into program formulation, review, decision and execution through the planning-programing-budgeting system."

Various definitions for Technology Assessment are being used. The most general one is that TA "is a type of policy research or systematic analysis directed toward the determination of the higher-order social and environmental consequences of technology (especially future technology) and possible solutions. Technology assessments will differ in methodology as a function of the specific problem, but will always aim to establish the potential desirable, undesirable and/or uncertain consequences of proposed technology."

An alternate definition offered by David Keifer of *Chemical and Engineering News* is useful as it emphasizes the social and managerial context of technology assessment:

". . . Technology Assessment is an attempt, still halting and uncertain, to establish an early-warning system to control, direct and, if necessary, restrain technological development so as to maximize the public good while minimizing the public risks. It is, no less, a new approach to allocating scientific resources, setting technological priorities, and seeking more benign alternatives to the technology already at hand. . . . Technological Assessment, then, is a mechanism for focusing on second- and higher-order consequences, for balancing their consequences against first-order benefits, and for asking new questions instead of merely trying to come up with better answers to old ones. . . ."

Furthermore, as we are talking about large-scale social problems requiring political/legal solutions, TA is an attempt to put the process of coping with the consequences of invention at least in *parallel* with technological development if not preceding it, rather than after the fact when it may be too late. The process then may be irreversible and it will most certainly be a more costly solution.

Technology assessment, it must be stressed, is basically a two-dimensional problem:

- Performing the TA study to establish a base of factual and analytical information.
- The political/legal process by which proposed solutions to problems identified will be *developed, applied* and *managed.* This will be part of the traditional advocacy/adversarial process which results in laws and administrative actions for all areas of public policy.

Technology Assessment also can be used in a positive and "aggressive" fashion by predicting second- and higher-order consequences, and by identifying technology gaps and future problems which suggest fruitful areas for new research and development.

Ray Bauers's book, *Second Order Consequences,* states: "It does not seem inconceivable that in the future we may have a deliberate national policy of phasing-in new technology so as to minimize the adverse social consequences."

The effects of such a policy on the Army could be so vast as to be impossible to predict at this time.

The main sources of information on Technology Assessment as of this writing are the documents issued by the Subcommittee on Research and Development of the House Committee on Science and Astronautics. Other sources of information are: The National Science Foundation; Dr. Louis Mayo at the George Washington University Policy Studies Program; and Science, Technology and Society Program at Cornell University, directed by Prof. Long; the Technology Assessment Program at Oklahoma State University, directed by Dr. Don Kash; Profs. T. Dixon Long and Melvin Kranzberg at Case Western Reserve University; Prof. Emmual Mesthene at the Harvard University Program on Technology and Society; Prof. Gene Skolnikoff, M.I.T. Department of Political Science; and Dr. Martin Jones, MITRE Corp., Washington, D.C.

Probably there are more methodology and technique proposals for doing Technology Assessments than there are people trying to use them, and others are undoubtedly on the way. The most general methods of approach at this time

(Continued on page 30)

Technology Assessment . . .

(Continued from page 29)

appear to offer the best methodology and allows for the use of whatever techniques from operations research, forecasting, statistics, behavioral and social sciences, computer sciences, and economics seems appropriate. This approach also allows for the development of whatever new techniques might be needed as the problem unfolded.

In general, TA will probably become a detailed systems analysis applied to the interaction of technology and society and techniques such as Delphi (quizzing of a panel of experts) will prove useful.

The easiest-to-follow TA methodology comes from a MITRE Corporation report to the Office of Science and Technology, authored by Dr. Martin V. Jones.

Seven major steps are suggested: Define the assessment task (scope and issues); describe relevant technologies (main, supporting and competitive); develop state-of-society assumptions (major nontechnological factors); identify impact areas (social characteristics which will be most influenced by the application of the assessed technology); conduct preliminary impact analysis (trace and integrate the process by which the assessed technology makes its social influence felt); identify possible action options; revise and complete impact analysis (based on each action option).

This approach, it should be noted, is only one generalized methodology. Each case will have to develop a methodology dependent on its particular problem, but no doubt many will incorporate some if not most of the above steps.

Bearing all of the aforementioned in mind, it appears obvious that the Army needs to develop an internal awareness of the issues, philosophy and methodology of Technology Assessment and a means of monitoring the external environment in order to anticipate the impacts of assessments performed by outside groups such as the National Academy of Sciences and the National Science Foundation.

This effort will prepare the Army for the requirement of maintaining an in-house capability, particularly at the developing agencies and laboratories where most of the technology problems exist, to perform TA studies.

The Department of the Army staff should serve as the stimulator, the innovator, the methodology experts and as one of many pipelines to keep the field apprised of the latest happenings. TA should be done by DA staff only as a means of studying methodology, or where a new systems of such magnitude is being considered that Army interest would be better served by performance on a DA staff level. TA needs to be performed by field activities which are face-to-face with the daily technological problems of the Army and which have potential societal impact.

The Office of the Chief of Research and Development, with the active participation of the developing agencies, is currently preparing to undertake an in-house, relatively informal training program to acquaint Department of the Army staff and developing agency personnel with the basics of technology assessment. A variety of outside government and academic people will be drawn upon for support.

In view of the foregoing and the climate of today's society, Technology Assessment has a significant *probability* of becoming an important input to the RDT&E and procurement decision-making process in the Army, but only after a serious awareness and awakening program. TA performed outside the military will also undoubtedly impact on Army decision-making and this will probably happen sooner. It is not too soon to think and act on Technology Assessment.

OSDOC II Joint Exercise

(Continued from page 5)

evaluated during OSDOC II.

- Gives technical assistance on the use and maintenance of the truck chassis, MILVAN containers, and other AMC-supplied equipment; plus assistance for design/fabrication of additional required equipment, and helicopter support beyond CONARC's capability.

AMC also establishes and chairs a Joint Task Group which coordinates the test and evaluations.

CDC has prepared the U.S. Army portion of the OSDOC II Outline Test Plan and is participating in the Joint Task Group to prepare a Test Plan.

CDC also prepared the U.S. Army portion of the budget estimate; identifies OSDOC II outputs desired for on-going CDC study efforts in containerization and related fields; and will provide the deputy Army test director and other assistance required by the Test Plan.

Within ODCSLOG the Directorate of Army Transportation is the Department of the Army staff proponent of the test evaluation and the Directorate of Aviation Logistics is coordinating the helicopter support and testing.

While OSDOC II is a joint exercise, the over-all goal is to expand the objectives and test the unique features each military service must consider in its own containerization system.

TSG Initiates Physicians' Assistants Program

The U.S. Army's Physicians' Assistant Program was initiated recently when Army Surgeon General (LTG) Hal B. Jennings Jr. addressed a class of 60 enlisted men and women at the Medical Field Service School, Brooke Army Medical Center, Fort Sam Houston, Tex.

GEN Jennings termed the highly selective first class and a similar group of 60 who will begin training later—chosen from among over 700 applicants—"The best of the best . . . standard bearers for success of the program.

"We sought individuals with extensive military medical training and experience, and we deliberately set a minimum limit of three years on the amount of military clinical experience they should possess.

"All of this was carefully considered and deliberately established—the premise being, not to entrust the care of any patient to any persons who have not learned through actual experience the needs of an ill or injured patient."

Final screening of applicants included comprehensive interviews and testing at Fort Sam Houston, following narrowing of the field based on extremely high standards of education, character, intelligence and leadership qualifications.

Twelve months of the 18-month course will be spent in the classroom and small group clinical exercises at Fort Sam Houston. Students will then receive six months of clinical training under the close supervision of Army physicians at U.S. Army hospitals. Final examinations will then be given at the Medical Field Service School.

Graduates will be commissioned as warrant officers and will receive an Associate in Science diploma with 60 semester hours of credit from Baylor University, which is affiliated with the Army in the program.

Tri Services, NASA, FAA Officials Meet at WECOM

Army, Air Force, Navy, Marine Corps, National Aeronautics and Space Administration, and Federal Aviation Administration officials from all parts of the nation participated in a recent Project SETE meeting at HQ U.S. Army Weapons Command, Rock Island, Ill.

SETE denotes Secretariate of Electronic Test Equipment and the project is sponsored by all of the agencies listed above as a national scientific and technical information activity. Management information also is exchanged in the specialized field of electronic tests, checkout and equipment.

The WECOM sessions were devoted to data banks relating to test equipment, both manual and automatic, and the exchange of knowledge and ideas among installations using or planning to set up data banks.

'THERMAL FINGERPRINT' Betrays Materials Defects as AMMRC Uses Infrared Nondestructive Testing

By Paul E. Vogel

New materials, unusual configurations and new processing methods present additional challenges in establishing nondestructive testing (NDT) techniques for Army materiel that will determine reliably whether or not specific quality criteria are met.

The Development and Engineering Laboratory of the Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass., operates with an exceptional pool of NDT talent and instrumentation; it prides itself on responsiveness to many NDT problems.

While the older and well-established methods such as X-ray, ultrasonics, penetrants and electromagnetics can often be adapted to an application, one new AMMRC technique has been demonstrating it can fill economically many voids in NDT technology, in terms of manpower and equipment.

This technique involves the detection and measurement of infrared radiation emitted naturally from any object that is warmer than absolute zero; and which, by translation of the resulting "thermal fingerprint" on the surface, reveals internal anomalies.

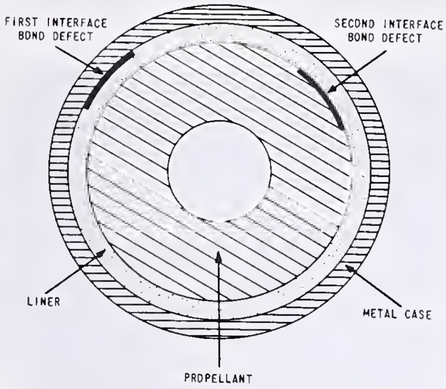
Research and development of infrared NDT at the AMMRC has proved its value in several interesting Army applications involving solid-propellant missile motors, rubber tires, vacuum-insulated containers, and foamed-in-place insulation.

MISSILE MOTORS. The AMMRC entered the field of infrared NDT in the early 1960s, when a technique was needed for testing nondestructively the bond integrity at the case-to-liner and liner-to-propellant interfaces of a missile motor.

A low-level heat injection on the surface of the missile produced a uniform heat flow except in areas where delaminations acted as thermal barriers and resulted in a heat buildup on the surface above the flaw.

The infrared radiometer that was used to detect this buildup is essentially a highly sophisticated, noncontacting thermometer. It can measure changes of minute fractions of a degree within a field of view small enough to examine differences within a one-eighth inch target if necessary.

PLY SEPARATIONS. Ply separations are a common cause of tire failure. AMMRC researchers have developed two techniques for detecting these flaws.



CYLINDRICAL MISSILE MOTOR CASE (cross section) showing the two types of bond defects that can occur in composites.

In one method the tire is spun under load at high speeds on a dynamometer. The constant flexing of the sidewalls and the friction between any plies that may be separated causes a hot spot that may be detected by IR-NDT.

The second technique is to rest an unmounted tire upon a turntable, subject it to a short pulse of high-intensity heat, and follow with infrared viewing of the heated area. As with the missile motor, a heat buildup on the surface indicates an interruption to the inward heat flow, usually caused by a ply separation.

VACUUM INSULATION TEST. Evacuation is a highly efficient means of insulating containers, ranging from large Dewars to the familiar picnic bottle and the Army Arctic canteen used to keep liquids in a fluid state at low ambient temperatures.

Until recently, loss of vacuum in Army Arctic canteens could be tested accurately only by the comparative measurement of an internal temperature change over an extended period of time. Now infrared temperature measurement of the exterior surface of canteens filled with hot water can show vacuum "leakers" in a 2-second test made only eight minutes after filling.

In addition to being able to identify leakers by an over-all exterior temperature elevation, the same test showed that an elevated temperature on a small surface area could indicate an unacceptable canteen not due to loss of vacuum. Instead, a lack of concentricity of the inner and outer canteen shells can allow contact between surfaces resulting in heat loss by conduction at that small area.

FOAMED-IN-PLACE TEST. Foamed-in-place insulations come in various formulations. Essentially they consist of two ingredients which, when combined, can be poured as a somewhat viscous fluid into a suitably large interstice. There it will foam, expand and (hopefully) provide a unicellular insulation of uniform density throughout the entire space.

Determination of the integrity of this type of insulation when foamed in a thin layer was made using a Barnes T-4 radiometer to scan an experimental insulated food container under Army development.

The container's two thermally separated inside compartments were heated to optimum temperatures. Conductivity through the walls then was observed as a function of exterior surface temperature. The "thermal fingerprint" could be validly correlated to known conditions of insulation.

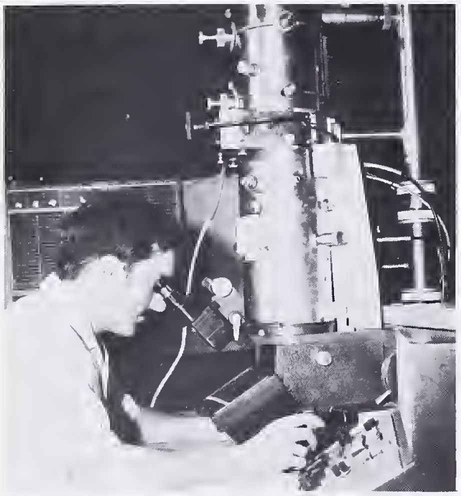
The cited examples illustrate how the Army has successfully utilized infrared techniques to solve some of its nondestructive testing problems in recent years. IR techniques are now used routinely to help resolve each new materials evaluation quandary.

PAUL E. VOGEL is employed in the Nondestructive Testing Branch, Development and Engineering Laboratory of the Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass. A 10-year employe of AMMRC and its predecessor agencies, he is responsible for research and engineering work in infrared and thermal testing.

Vogel is credited with development of pioneering techniques for infrared and holographic nondestructive testing. Author of many articles and several technical reports, he has been active in the work of various technical societies. In the Society for Nondestructive Testing, he has served as chairman of several committees and presented a variety of papers.

Career Programs . . .

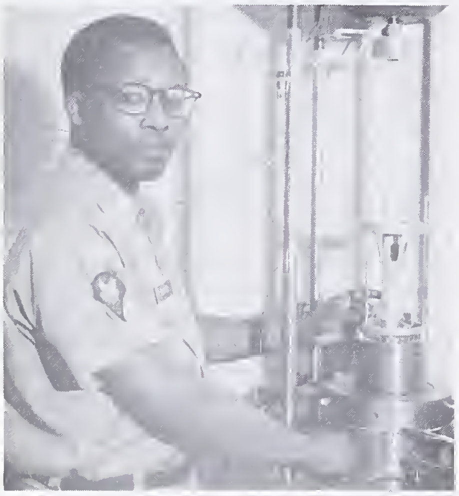
Will MVA Recruits Respond to Challenge of Careers in Highly Successful S&E Program Since 1948?



SP4 John M. McMahon

SP4 Robert Zadronzy

SP4 Albert Jackson Jr.



SP4 Willie D. Brown

SP4 Darryl J. Calkins

What effect will full dependence upon recruitment for the Modern Volunteer Army have on the most successful program—as proved by results since 1948—to utilize to the best possible advantage the special talents of college and university graduates?

The future of the Army Scientific and Engineering (S&E) Program for Enlisted Men may well depend upon the answer to that question—by how many young men and women will volunteer for the opportunity of careers in Army research and development. Currently, the quota for the S&E Program is approximately 1,700 selectees.

How selective is this group? Only those with master's degrees, or bachelor's degrees plus applicable work experience in certain fields, are presently being considered. Candidates also are carefully screened for other qualities to maintain the high standards of professionalism that have made the program exceptionally rewarding to the Army.

Participants have found the program no less rewarding to themselves. They have had the opportunity to advance substantially their professional career interests by working alongside the Army's civilian career scientists and engineers in challenging research and development assignments. Many of them have made notable contributions to high priority areas of Army effort.

Upon being released from military duty, numerous members of this select group have decided to accept offers of civilian employment in the laboratories they served while in uniform. Some of them have gone on to high-grade positions, and a few to key scientist status, either with the Army or other defense agencies.

Even for those who prefer to pursue careers in the civil scientific and engineering community, the experience they have gained while engaged in Army research proves invaluable to them in striving toward their goals—in fact, considerably enhances their prospects of finding good jobs by enriching their applicable experience.

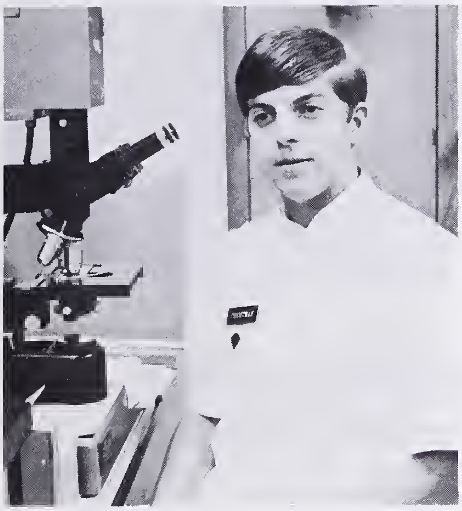
To appreciate how the military occupations and civilian career interests of S&E personnel have proved valuable to them and the Army, one has only to consider their training, career intentions, and their military utilization. Illustrative examples include:

SP4 DAVE AKINS received his bachelor's degree and teaching credentials from Humboldt State College in California, taught for three years, then earned a master's degree from San Diego State College. Since both his degrees are in mathematics, his S&E program assignment is mathematics-statistics assistant, Office of the Comptroller, U.S. Army Strategic Communications Command, Fort Huachuca, Ariz. He is working on STRATCOM cost factor analysis.

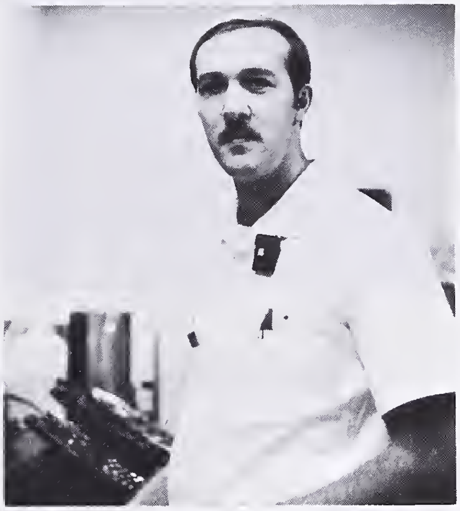
PFC RONALD BARBER received a BS degree in chemistry from St. Cloud State College in Minnesota, then worked as a senior research technician with Minnesota Mining and Manufacturing Corp. until he was called to Army service. In his assignment with Walter Reed Army Institute of Research (WRAIR) as a physical sciences assistant, he works on research associated with the Army's Drug-Screening Program.

SP4 WILLIE D. BROWN was recently discharged from the Army under "early-out" policy. Now studying toward his PhD under a fellowship at Brown University, he has a BS degree in physics from Louisiana Southern University and an MS degree in physics from Purdue University. While in the S&E Program, he was assigned to the Army Corps of Engineers Waterways Experiment Station, Vicksburg, Miss., where he tested soils for the evaluation of Minuteman defensive missile sites.

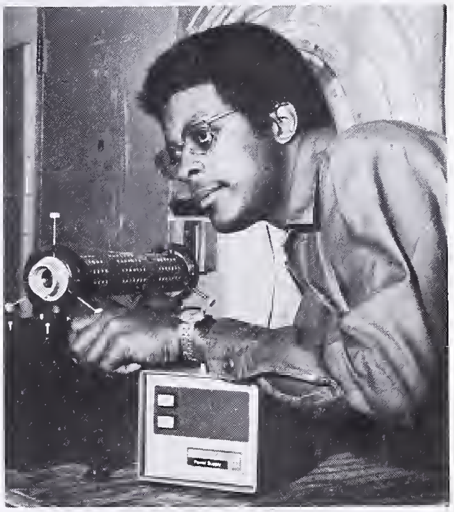
SP4 STEPHEN G. BUDA, assigned to the Cold Regions Research and Engineering



SP4 James C. Christman



SP4 Carl W. Erkenbrecher Jr.



PFC Hurley T. Davis

Laboratory (CRREL), Hanover, N.H., is engaged in research in sanitary engineering on a wide variety of environmental and pollution abatement projects. He also is participating in a study of waste water treatment in various regions of the United States. His qualifications for this work include bachelor's and master's degrees in civil engineering from Wayne State University, Detroit, Mich.

SP4 DARRYL J. CALKINS, also assigned to CRREL, is studying the drifting of snow, involving research on the use, development and analysis of snow control devices. A native of Vermont, he holds a bachelor's degree from the University of Maine and a master's, both in civil engineering, from the University of New Brunswick.

SP4 JAMES C. CHRISTMAN has a bachelor's degree in chemistry from Lehigh University and a master's in biology from Johns Hopkins University. He is assigned as a bacteriology assistant with the First Army Medical Laboratory, Fort Meade, Md., where he concentrates on chromosomal studies in the Cytogenetics Service.

SP4 Christman plans to attend medical school when he is discharged, and feels that his experience in S&E has been a "valuable preparation for a medical career." It has afforded him exposure to patient-doctor relationships, involvement with actual laboratory medicine and medical practice, and association with physicians on a professional level.

SP4 DANIEL J. COOMBES, assigned to CRREL, designed and now operates an electronic control and measurement system for dynamic soil testing. Information obtained from his research is utilized in the design of structures and foundations for cold regions. He is from Willow Springs, Ill., and obtained bachelor's and master's degrees in electrical engineering from the University of Illinois.

PFC HURLEY T. DAVIS, stationed at CRREL, is setting up an experimental program to measure the optical properties of sea ice. The problem areas are concerned with techniques of growing samples of sea ice, machining and polishing samples to an optical finish, and conducting optical extinction experiments using a helium neon laser.

A native of Mobile, Ala., he received a bachelor's degree in physics from Tuskegee Institute and participated in graduate studies at the University of Maryland.

SP4 CARL W. ERKENBRECHER JR., a biological sciences assistant, works in the Division of Nuclear Medical Services at the First Army Medical Laboratory, Fort Meade, Md. In addition to his bachelor's degree in microbiology and biochemistry from Furman University, he has done graduate work in marine bacteriology and biochemistry at the University of South Carolina.

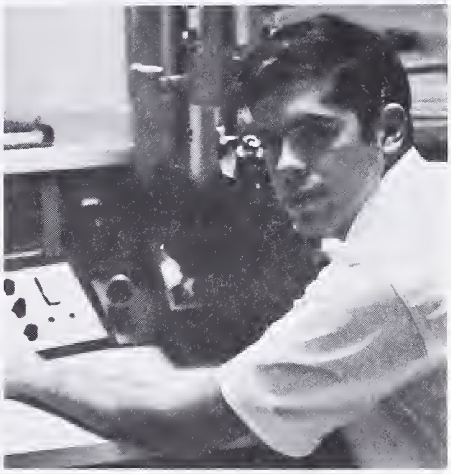
He brings to his military job the experience gained in the microbiology research laboratory of a major pharmaceutical company. Currently, he is considering study toward a PhD degree in medical microbiology.

SP4 GARY B. FRIDEN is a Phi Beta Kappa graduate in physics from the University of Colorado who worked in the Nuclear Physics Laboratory of that school before he entered the Army in August 1970.

As an S&E specialist, he is a physicist on the Systems Analysis Team, Visionics Area, at the Night Vision Laboratory, Fort Belvoir, Va. As project engineer for image processing research, he is engaged in computerized simulation and the design of night-vision devices.

SP4 ALBERT JACKSON JR. is a mathematics-statistics assistant with the Materiel Testing Directorate at Aberdeen Proving Ground, Md. His supervisor reports he has assisted in developing and perfecting the Army Test and Evaluation Command (TECOM) test resource management system while on loan to TECOM.

(Continued on page 34)



SP4 Anthony W. Scotto

SP4 Gary B. Friden

PFC Ronald Barber

SP4 Daniel J. Coombes

PFC Wallace P. Murdoch Jr.

SP4 Dave Akins

SP4 Kim Weaver

career
programs

Will MVA Recruits Respond to Challenge Of Careers in Highly Successful Program?

(Continued from page 33)

Jackson has an associate of science degree with distinction from his hometown Georgia Military College at Milledgeville, and a BS degree in mathematics from Atlanta's Morehouse College.

SP4 DAVID W. JOHNSON is a biological sciences assistant in the Environmental Health Section, First Army Medical Laboratory, Fort Meade, Md., where he analyzes chemical characteristics of water and waste water with regard to health and environment, He has an associate's degree in forestry, a bachelor's degree in biology, and a master's degree in fisheries research, all from the University of Idaho.

Until he entered the Army, he worked with fisheries in the New York State Conservation Department and taught high school biology and chemistry. Upon his discharge from military service, he intends to continue graduate study in water quality at Cornell University and to pursue a career in conservation education and water quality.

SP4 JOHN M. McMAHON is assigned to the Department of Nephrology in the Division of Medicine, Walter Reed Army Institute of Research, where he uses electron microscopy to study some of the aspects of kidney failure.

He received a bachelor of science degree in biology from Cornell University and, until he entered the Army, was working toward a PhD in virology at the medical school of the University of New Mexico. When he is discharged, he intends to attend medical school in his home State of New York.

PFC WALLACE P. MURDOCH JR., before entering the Army, worked three summers for the Smithsonian Institution. One summer he spent in West Africa as a member of a mammal and ectoparasite collecting team. He also has worked for the U.S. Forest Service as a field entomologist.

Currently, he is biological sciences assistant at the First Army Medical Laboratory, Fort Meade, Md. He is involved in the study of housefly and cockroach insecticide resistance, although his basic work is as a mosquito taxonomist. His bachelor's degree is in entomology, with a minor in applied statistics, from Utah State University, and he plans to work for a master's degree and a PhD when he returns to civilian status.

SP4 ANTHONY W. SCOTTO reports that in his assignment with the First Army Medical Laboratory, Fort Meade, he has utilized and enlarged upon his civilian training in research on renal failure. He has a bachelor's degree in biology from C. W. Post College, a master's degree from Long Island University, and at the time he entered the Army was working on a PhD in microbial physiology.

During his Army tour he has continued graduate studies at the National Institutes of Health. When discharged from military service, he intends to study for his doctorate.

SP4 KIM WEAVER is assigned to the Personnel Management Division, HQ STRATCOM, Fort Huachuca, Ariz. His duty involves use of a remote computer terminal to identify personnel for managerial and staff assignments; also, to monitor command strength and military occupational inventories.

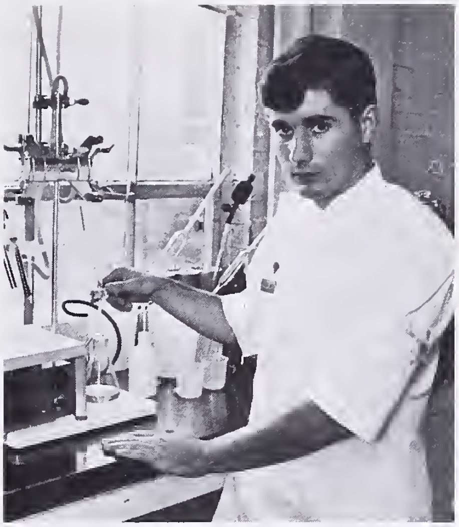
A native of Worland, Wyo., he received a bachelor's degree in zoology and a master's degree in statistics, both from the University of Wyoming. When discharged, he intends to combine the two skills in a study of biostatistics.

SP4 LARRY L. YOUNG from Arnoldsville, Ga., is assigned to the Food Analysis Section, Veterinary Division, First Army Medical Laboratory, Fort Meade, Md. He analyzes food products to insure that they meet the chemical and biological requirements of Army contracts and federal specifications.

His qualifications for this task include bachelor's and master's degrees in food science from the University of Georgia, and work in food applications research at Moffett Technical Center, CPC International, Inc., Argo, Ill.

Currently, he is studying toward a master's degree in business administration at George Washington University, and plans to enter the food marketing field when released from military service.

SP4 Larry L. Young



SP4 David W. Johnson

SP4 Stephen G. Buda

SP4 ROBERT ZADRONZY received his bachelor's degree in electrical engineering from Illinois Institute of Technology, and worked as a development engineer with Western Electric before he entered the Army.

Assigned to the Communication Engineering Directorate, HQ Communications Electronics Engineering Installation Agency, Fort Huachuca, Ariz., he is concerned with implementation of the U.S. Army Autovon system linked to the European telephone system. After release from the Army he expects to return to his former job with Western Electric Co.

Unquestionably, the "sweetest" assignment ever received by any participants in the S&E Program was that given to former E5 James S. Weber and E4 Richard Parizek. Weber worked (1967–69) at the Natick (Mass.) Laboratories and Parizek succeeded him (1969–71).

Both were cited for notable contributions to the team of nine researchers who developed an enzymatic process to convert waste papers of various types into glucose food products, including sugar or a clean-burning fuel (ethanol). This has been termed potentially one of the most significant research achievement at NLABS in 25 years.

Leaders of the Scientific and Engineering Program for Enlisted Men report that little can be predicted with certainty at this time regarding the impact upon the program when the draft is eliminated.

Although the men in S&E assignments seem happy with the program, approximately 95 percent of them are draftees. A survey of their intentions indicates most will probably leave the service when their tours are completed. The S&E Program is presently thriving, however, and is filled to capacity.

When the Modern Volunteer Army becomes fully effective, many officers and civilian officials feel that it will not be possible to persuade college and university graduate trained professional scientists and engineers to serve in the Army as enlisted men.

This feeling is shared by CW2 Lewis H. Jacobsen of the Office of Personnel Operations (OPO), one of the S&E Program administrators. He pointed out that during last year's June-October hiatus in the Selective Service Act, input to the program dropped to a trickle, but resumed its former volume as soon as the draft was reactivated.

Another view is that currently unfavorable economic trends, affecting the academic world as well as the industrial development community, might encourage young engineers and scientists to join the Army if they could be assured of this kind of duty. Presently though, since it is a relatively small program, a man may not enlist with any promise of placement in S&E assignments.

Engineers Attend Environmental Conference at AEHA

Military and civilian sanitary engineers involved in the Army's worldwide ecological problems exchanged information at the 7th annual conference held recently at the U.S. Army Environmental Hygiene Agency (AEHA), Aberdeen Proving Ground, Md.

COL Hunter G. Taft Jr., AEHA CO, was host to the conference attended by about 80 engineers concerned with environmental matters confronting military and civilian communities. They represented Army commands from throughout the United States and overseas.

Primary emphasis was on techniques for the control of elimination of conditions detrimental to the general environment as related to health engineering and sanitation.

A keynote speaker and guest of honor, COL Bernard L. Goldstein, assistant chief of the Army Medical Service Corps, and also chief of the Sanitary Engineering Section, Office of the Army Surgeon General (OTSG), stressed environmental problems and difficulties being encountered in all areas and at all levels of military command.

The principal purpose of the conference, he explained, was to inform participants of the latest methods for relating man with his environment and for applying broader knowledge to its enhancement.

Technical information was exchanged through the presentation of papers and in discussions among seven working groups.

Resulting recommendations have been forwarded to OTSG to provide a new insight into environmental problems of concern to the Army.

The information will be used in developing Army programs and revising Army regulations and administrative procedures in solving environmental problems.

AEHA CONFERENCE participants (l. to r.) COL Bernard Goldstein; COL Hunter Taft Jr.; COL Joseph Shewski, Office of the Chief of Engineers; and Dr. Mackenzie Davis, U.S. Army Construction Engineering Research Laboratory, University of Illinois.

Conferences & Symposia . . .

Standardization Discussions Held at Presidio

Quadripartite Standardization Discussions (TEAL), involving senior Army officers of America, Britain, Canada and Australia, are scheduled May 22-26 at the Presidio of San Francisco, Calif. Sixth Army Commanding General (LTG) A. D. Surles Jr. is chairman.

Held under auspices of the ABCA Armies Standardization Program, the TEAL XVI discussions will be conducted at vice chief of staff level. The stated purpose is to:

- Provide a quadripartite forum for the free exchange of information on national concepts and related materiel requirements.
- Provide the Washington (D.C.) Standardization Officers, who manage the ABCA Armies Standardization Program, an opportunity to brief the vice chiefs of staff, on its current status.
- Provide guidance and impetus to the program; also, to recommend to the ABCA Armies how the interests of standardization should be furthered.

The original meeting in this series of discussions was the "Tripartite Conference on Tactics—1957." Hosted by the United Kingdom, its purpose was to "review the tactical concepts of the Tripartite Armies for the period 1960–70, and to consider major differences, with the aim of facilitating maximum tactical collaboration and materiel standardization."

Subsequent annual discussions were given the title of TEAL and became quadripartite in 1964 when Australia joined the Standardization Program.

The agenda for TEAL XVI provides for formal presentations on aspects of national operational concepts and development programs of major importance to the ABCA Armies. Time is set aside for framing of formal recommendations which, when approved by the Armies, will provide further Standardization Program guidance.

Within the TEAL conference room, an informal atmosphere encourages the free and frank exchange of ideas and concepts. A closed session provides heads of delegations an opportunity to explore controversial areas.

LTG John Norton, commanding general of the U.S. Army Combat Developments Command, will head the U.S. Delegation to TEAL XVI. Supporting him will be representatives of his command, the Office of the Chief of Research and Development, the Army Materiel Command, Office of the Assistant Chief of Staff for Force Development, and the Office of the Chief of Engineers.

Heads of other national delegations are Lt Gen Sir Cecil Blacker, Vice Chief of the General Staff of the British Army; Lt Gen G. A. Turcot, commander of Mobile Command, Canadian Forces; and Maj Gen S. C. Graham, Deputy Chief of the General Staff, Australian Army.

New Zealand, which is associated with the ABCA Standardization Program through Australia, also will be represented.

The value of the TEAL discussions is emphasized by the fact that no other forum exists in which the ABCA Armies meet at this high level with the express purpose of fostering standardization of equipment and procedures enabling them to operate together more effectively.

The TEAL discussions also point the way to achieving large savings in costs of national R&D programs by avoiding duplication of effort.

TECOM Parley Decides FY 73 Program of Testing

The eighth annual Environmental Test Planning Conference sponsored by the U.S. Army Test and Evaluation Command (TECOM) has resulted in the scheduling of 157 tests of materiel and equipment during Fiscal Year 1973.

More than 100 conferees at the Aberdeen (Md.) Proving Ground meeting included representatives of the Army Materiel Command (AMC), U.S. Army Alaska, and environmental test centers that assist TECOM in development of its List of Materiel Requirements (LMRs) slated for testing. Nearly 400 items were considered.

MG Charles P. Brown, commanding general of TECOM, explained that the basic purpose was to provide a plan of action that would guide all attendees toward the accomplishment of the test and evaluation mission.

He emphasized that TECOM must be able to control and allocate its resources for the conduct of test operations. Developers must furnish TECOM the test items in a timely manner, together with spare parts support and proper maintenance packages.

Three committees submitted LMRs applicable to their respective areas of interest. These presentations were made by COL David J. Schumacher, commanding officer of the U.S. Army Arctic Test Center; COL Robert F. Callahan, chief of testing at the U.S. Army Tropic Test Center; and COL George A. Custer, director of testing, Yuma Proving Ground.

Approval of the lists by AMC and the Department of the Army will result in the consolidated environmental test program for FY 73.

ARCTIC TEST CENTER commander, COL David J. Schumacher points out features of most recently standardized arctic uniform, displayed on manakin during TECOM Environmental Test Planning Conference, to COL Robert F. Callahan (left), MG Charles P. Brown (2nd from right), TECOM commanding general, and COL George A. Custer.

SCIENTIFIC CALENDAR

26th Annual Frequency Control Symposium, sponsored by AMC, Atlantic City, N.J., June 6–8.

Panel Workshop on Basic Research in Malaria, sponsored by OTSG, Washington, D.C., June 7–9.

2d U.S. Computer Solo Exhibition Technical Program, sponsored by IEEE, Tokyo, Japan, June 8–13.

1972 Heat Transfer and Fluid Mechanics Institute, sponsored by ARO-D. ONR and NSF, Northridge, Calif., June 14–16.

Summer Symposium on Coordination and Transition Metals, sponsored by ARO-D and State U. of New York, Buffalo, N.Y., June 18–21.

4th International Congress of Endocrinology, sponsored by NIH, Washington, D.C., June 18–23.

Business Planning Symposia, sponsored by CD Corp., Washington, D.C., June 19–21.

International Conference on Nature of Metal-Amonia Solutions: Colloquium III, sponsored by ARO-E, Tel-Aviv U., Israeli Academy of Science and Israeli Council for R&D, Upper Galilee, Israel, June 19–23.

Army Science Conference, sponsored by OCRD, West Point, N.Y., June 19–23.

Joint Measurement Conference, sponsored by IEEE, ISA, NBS. NCSL. ASQC and PMA, Boulder, Colo.. June 21–23.

35th ADAPSO Management Conference, Boston, Mass., June 22–23.

75th Annual Meeting and 20th Materials Testing Exhibit, sponsored by ASTM, Los Angeles, Calif., June 25–30.

DPMA International Data Processing Conference and Business Exposition, N.Y.C., June 27–30.

Summer Power Meeting, sponsored by IEEE, San Francisco, Calif., July 9–14.

Conference on Dynamic Crack Propagation, sponsored by ARO-D, Air Force, ONR and AEC, Bethlehem, Pa., July 10–12.

IUPAC Symposium on Photochemistry, Baden-Baden, West Germany, July 16–22.

Advanced Study Institute on Physics and Chemistry of Upper Atmospheres, sponsored by ARO-D. BRL and APG, Orleans, France, July 31–Aug. 11.

Man, Environment, Usufruct . . .

"The earth belongs always to the living generation. They may manage it then, and what proceeds from it, as they please during their usufruct."

Spoken by Thomas Jefferson nearly 200 years ago, this is a foremost thought today as the nation speculates on the role of man and his relationship to the earth environment.

In the 1970s, ecology has become an essential aspect of everyday life, not only for the population in general but in particular for scientists and engineers, in research and development.

Addressing environmental considerations in a comprehensive framework are many segments of the American community—government, industry, science and the military.

Today, four dimensions of the environment must be treated in the technological progress. One is ecological—plant and animal life. The other three are physical—air, land and water; aesthetic—visual impact on the environment; and human—man's well-being and factors contributing to the enjoyment of life.

The National Environmental Act of 1969 linked these considerations to legal requirements. Now, all plans for major projects receiving federal funds must be accompanied by an environmental impact statement in the planning stage.

The goal of a cleaner America is a major objective and the FY 73 budget of the Environmental Protection Agency (EPA) is being continued at a high level to expand a number of programs.

EPA Administrator William D. Ruckelshaus stated in his recent budget message: "We will undertake larger efforts in research and development in control technology for air pollution, in regional studies of air pollution, and in research on health effects of air pollution."

Ruckelshaus said the largest part of the new EPA budget is $2 billion in federal matching grants to local governments for construction of sewage treatment facilities. This will help localities meet a major challenge—the construction, maintenance, and operation of adequate waste treatment plants.

This is part of the government's 3-year program of $6 billion in federal funds to help upgrade the quality of the nation's waters, to protect public health, and to improve the aesthetic aspects of lakes, rivers and harbors.

The U.S. Army has a major role to play in this effort. Army Engineer programs touch in many ways on what happens in the nation's rivers, harbors, coasts and tidal areas, and the offshore continental shelf.

"More significantly," Army Chief of Engineers LTG F. J. Clarke recently said, "they also touch on the cost of power, transportation, and water, and through them on the final cost of products."

The Army Engineers' oldest job—that of maintaining and developing waterways—puts the Army in the business of dredging every commercial harbor in the United States, every channel leading to it, deepening it when required, and keeping it clean of debris which would be a serious hazard.

The extent of the Army Engineers' responsibilities in these ecological activities was stressed by General Clarke:

"We develop and maintain some 22,000 miles of inland waterway which carry about one-sixth of the nation's commerce, mostly in bulk cargo. We provide about 13,000,000 kw of hydropower at our projects—not a great deal as a percentage of the total power supply of the U.S., but becoming more important every day as peaking power. . . .

"Since navigable waters include all of the tidal marshes, we find ourselves concerned with all sorts of plans to fill the marshes for homes or industrial sites, or even for garbage dumps."

Ecology is involving every segment of the American society. Focusing on engineers, Neil L. Drobny, an environmental planner at the Columbus Laboratories of Battelle, said that in future studies they will have to consider carefully aesthetic and social factors in formulating their plans and projects.

"It is no longer acceptable," he told participants at the Water Resources Conference of the American Society of Civil Engineers, "to take the traditional approach of lumping these factors into a catch-all area termed intangibles which are brushed over as something we would like to know but which we don't take the time to investigate."

Thus, although Jefferson saw all generations merely as tenants for a time, behind his concept of freedom "to do as you please" was an implicit call for conserving resources and, as EPA Administrator Ruckelshaus said, "handing them on to the next generation in perpetual husbandry."

Numerous ongoing programs and continuing consideration of new or expanded R&D programs to improve technological control and abatement of pollution attest to the diligence of the U.S. Army, along with other U.S. Government agencies and all segments of society, in working toward this objective.

DA Reprints HumRRO Handbook

"Handbook on Volunteers in Army Community Service," a Human Resources Research Organization manual, has been reprinted as Department of the Army (DA) Pamphlet 608-28.

Bearing the same title, the DA pamphlet is being sent to Army units through the "pinpoint distribution system."

ABCA Delegates Discuss Chemical Weaponry

Military and civilian scientific personnel from Canada, Australia, England and 19 U.S. Armed Forces activities attended a recent 2-day technical conference at Edgewood Arsenal, Md.

Technical Director Dr. B. L. Harris welcomed the international delegation to what is expected to be the first of a series of related meetings.

The meeting opened with a briefing on the arsenal's role in developing the new binary chemical weapon system, the search for new agents, analytical research, incapacitating agents and detection research.

Discussions were held on chemical agent detection and alarms, flame and incendiary research and munitions, riot control agents and dissemination devices, chemical testing and assessment, biological detection and protection, prophylaxis and therapy studies, chemical disposal, aerodynamic research, and nonlethal kinetic weapon systems.

U.S. attendees included representatives from two Air Force commands, the Naval Research Laboratories, the Marine Corps Development and Education Command, 14 major Army activities and the federal Public Health Service.

EDGEWOOD ARSENAL commander COL John K. Stoner Jr. (center) and technical director Dr. B. L. Harris discuss the arsenal's research and development role with Marine COL George Balzer, Office of the Joint Chiefs of Staff Department of Defense.

Personnel Actions . . .

Magill Takes Over From Nolan As Kwajalein Acting Director

LTC Henry F. Magill

COL Hubert L. Nolan

LTC Henry F. Magill, an R&D Officer Program enrollee since 1963, has been assigned as acting director of the Kwajalein Missile Range Directorate, Safeguard System Command, Huntsville, Ala.

COL Hubert L. Nolan vacated that position when he retired recently with more than 30 years Army service. Both men are well known to the Army R&D community, having served on the headquarters staff of the Chief of R&D and in a variety of R&D assignments within the past decade.

LTC Magill has served as chief, Systems Engineering Division, Advanced Research Projects Agency-Vietnam (1970); Ordnance officer, Berlin, Germany (1969); battalion commander, 3d Armored Division, Germany (1967–68); and staff officer, Physical and Engineering Sciences Division, U.S. Army Research Office (USARO), OCRD (1963–67).

He also served as project engineer, Joint Task Force Eight; Army representative, Down-Range Antimissile Measurement Program, Eastern Test Range; chief of the Plans Branch, Antimissile and Space Defense Projects Office, Redstone Arsenal, Ala., and aide-de-camp to MG John B. Medaris when he commanded the Army Ballistic Missile Agency.

LTC Magill earned a bachelor's degree in engineering from Clemson University (1951) and a master's degree in engineering science from the University of Alabama (1961). He also has completed Artillery and Ordnance officers advanced courses, graduated from the Army Command and General Staff College, and is a member of the 1972 nonresident class of the Army War College.

His awards and decorations include the Bronze Star Medal, Meritorious Service Medal, Joint Service Commendation Medal, Army Commendation Medal with three Oak Leaf Clusters, and the Vietnam Medal of Honor.

COL NOLAN was assigned to the Safeguard System Command in September 1968 as chief of the Technical Operations Division, Site Activation Directorate and became director of the office a year later. In June 1970, he became director of the Kwajalein Range Directorate.

The colonel served nearly three years as deputy chief of the Physical and Engineering Sciences Division, USARO, OCRD, following a tour of duty as deputy and chief of the Plans and Operations Division, U.S. Army Combat Surveillance Agency, Arlington, Va. (1959–62).

Other stateside tours include assignments with the U.S. Army Materiel Command in Washington, D.C.; Combat Surveillance and Target Acquisition Agency, Washington, D.C.; Ordnance Training Command, Aberdeen Proving Ground, Md.; and Rossford Ordnance Depot, Toledo, Ohio.

COL Nolan, whose World War II service included the China-Burma-India Theater, holds a BS degree from Georgia Institute of Technology (1940) and an MS degree in mechanical engineering from Purdue University (1952). A graduate of the Command and General Staff College, he holds the Legion of Merit, Bronze Star Medal and Army Commendation Medal with Third Oak Leaf Cluster.

Dr. Carlson Gets Key AAMRDL Post

Dr. Richard M. Carlson

One of the key executive technical positions in the U.S. Army Air Mobility Research and Development Laboratory has been filled by appointment of Dr. Richard M. Carlson to head the Advanced Systems Research Analysis Office.

Selection of Dr. Carlson, until recently with Lookheed-California Co., was announced by Paul F. Yaggy, director, Army Air Mobility R&D Laboratory, Ames Research Center, Moffett Field, Calif.

Dr. Carlson has distinguished himself during 24 years in rotary-wing aeronautics and has spent much of his career in the research, development, design, and evaluation of helicopters.

He is an associate Fellow of the AIAA, a member of the American Helicopter Society, a Fellow of the Royal Aeronautical Society, and was the first foreign member of the Swedish Society of Aeronautics and Astronautics.

Dr. Carlson has been a lecturer in aeronautical engineering at Stanford University since 1958, conducting courses in VTOL aerodynamics and aeroelastic problems, and VTOL configuration design. He is a registered mechanical engineer in the State of California, and has been a Federal Aviation Administration designated engineering representative (structural) since 1952. He received his PhD degree in engineering mechanics from Stanford University.

Moore Becomes District Engineer in New York

LTC Robert L. Moore, director of Plans and Analysis, HQ Army Materiel Command (AMC), has been named district engineer at Buffalo, N.Y., succeeding COL Ray S. Hansen.

He served as an Infantry officer for seven years prior to 1959, when he transferred to the Corps of Engineers, and has had troop and staff assignments in Japan, Korea, Europe and Vietnam.

Commissioned through ROTC at Virginia Polytechnic Institute, LTC Moore holds a BS in architecture from there, a BS in civil engineering from the Missouri School of Mines, and a master's degree in business administration from George Washington University. He is also a graduate of the Command and General Staff College and the Industrial College of the Armed Forces.

He has served as staff officer, Office of the Deputy Chief of Staff for Logistics, Department of the Army; commander, 553d Engineer Battalion (Construction) in Europe; commander, 87th Engineer Battalion (Construction) in Vietnam; and assistant executive officer, Office of the Assistant Vice Chief of Staff, Department of the Army.

Delbridge Heads Pittsburgh Engineer District

LTC Norman G. Delbridge, chief of the Surveillance, Target Acquisition and Night Observation Division, Office of the Chief of Research and Development (OCRD), will become district engineer in Pittsburgh, Pa., in June.

A 1953 graduate of the U.S. Military Academy, with a BS degree in engineering, he has an MS degree in civil engineering from Iowa State College. A registered engineer in Iowa, he is a graduate of the Infantry School, Engineer School, Command and General Staff College, and the Army War College.

His previous assignments include: CO, 16th Engineer Battalion, 3rd Infantry Division, Korea; assistant professor of military science, ROTC, Michigan State University; assistant area engineer and chief of construction for the Army Engineer and chief of construction for the Army Engineer Division in the Mediterranean; operations officer, Engineer Section, I Field Force, Vietnam; commander, 4th Engineer Battalion, 4th Infantry Division, Vietnam; and chief of Assignments, Engineer Branch, Office of Personnel Operations, Department of the Army.

MG Raymond Takes Post as Engineer for SAD

MG D. A. Raymond

MG Daniel A. Raymond, former director of military construction in the Office, Chief of Engineers, Washington, D.C., is the division engineer for the South Atlantic Division of the Army Corps.

MG Raymond directs planning, engineering, design and construction of civil works and military construction projects in the southeastern United States, Panama, Puerto Rico and the Virgin Islands.

Graduated from the U.S. Military Academy (USMA) and commissioned in the Army Corps of Engineers in 1942, he received an MS degree in civil engineering from Harvard University in 1949. He is a graduate of the Command and General Staff College and the Army War College.

MG Raymond has served with the Army Amphibious Forces in North Africa and the Mediterranean; 3d Infantry Division in Europe; CO, 13th Engineer Combat Battalion, 7th Infantry Division; Deputy District Engineer, Okinawa District; District Engineer, Mobile, Ala.; Army Office of Personnel Operations; Deputy Assistant Chief of Staff, Logistics, for Engineering Military Assistance Command (MACV) and as Director of Construction, MACV.

WES Assigns New Hydraulics Chief

Henry B. Simmons

Henry B. Simmons is the new chief of the Hydraulics Division, U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss., following service for a year as acting chief.

Simmons' service in hydraulic engineering spans 32 years at WES. Promoted to chief of the Estuaries Branch in 1943, he served in this capacity until 1970.

As the engineer in charge of the oldest WES division, Simmons will direct physical and mathematical modeling of water resources development projects, including prototype investigations of structures.

With the primary mission of supporting flood control, navigation, harbor development and other water resources projects, the Hydraulics Division is currently engaged in its largest program of cost-reimbursable work. More than $4 million of R&D for various agencies is programed in FY 72.

Simmons, who has developed or participated in the development of instrumentation and techniques used for hydraulic models of estuaries serves on the Corps of Engineers Committee on Tidal Hydraulics.

Dr. Johnson Heads New AEC Division

Dr. Gerald W. Johnson has taken over as director of the Atomic Energy Commission's Division of Applied Technology, which combines the former Divisions of Isotopes Development and Peaceful Nuclear Explosives.

Dr. Johnson, a physicist, had been president of JERAC Co., which he formed in 1971, following three years as manager of Explosives Engineering Services, Gulf Energy and Environmental Systems, in San Diego, Calif.

Dr. Johnson began his career in nuclear energy at Brookhaven National Laboratory in 1949. Two years later he headed the Analysis Branch, Nuclear Weapons Effects, in the Armed Forces Special Weapons Project, Department of Defense. In 1951, he participated in the first field test in Nevada in which a nuclear explosive was used to make a crater.

Appointed by President Kennedy in 1961 to be chairman of the Military Liaison Committee to the Atomic Energy Commission, he also served as special assistant to the Secretary of Defense for Atomic Energy. From 1966 to 1968, he served as director of Navy Laboratories.

Dr. Johnson holds BS and MS degrees from State College, Washington, and a PhD in physics from the University of California.

STRATCOM Assigns Dunlop at DCS, P&O

COL John Dunlop

COL John Dunlop has been selected as deputy chief of staff, Plans and Operations, U.S. Army Strategic Communications Command (STRATCOM), Fort Huachuca, Ariz.

In 1970–71 he served as deputy chief of staff (operations) 1st Signal Brigade and commander of the brigade's 21st Signal Group in the Republic of Vietnam, STRATCOM-Pacific. He has served tours of duty in West Germany, Ethiopia, Taiwan, and in Washington, D.C., with the Defense Communications Agency and the Office of the Chief Signal Officer, Department of the Army.

COL Dunlop is a graduate of the Signal Officer Advanced course, the Army Command and General Staff College, and the Armed Forces Staff College.

USACSC Selects Higgins as Deputy (MIS)

COL William W. Higgins, until recently deputy chief of staff, Management Information Systems, HQ U.S. Army Security Agency, is now deputy for Management Systems, U.S. Army Computer Systems Command (USACSC), Fort Belvoir, Va.

During the last 10 years his major assignments have included: technical liaison officer, Office of the Assistant Chief of Staff for Intelligence, Washington, D.C.; commander, 51st U.S. Army Security Agency Special Operations Command, Okinawa and Taiwan; assistant deputy chief of staff, Research and Development, HQ U.S. Army Security Agency; commander, 509th Radio Research Group in Vietnam. He also served with the 4th Field Division in Vietnam.

A graduate of the Command and General Staff College and the U.S. Army War College, he holds a BS degree from the University of Maryland and a master's degree in public administration (technology management) from American University.

Dehrkoop Named CO of CEEIA-WE

LTC Clinton B. Dehrkoop was recently named CO, U.S. Army Communications Electronics Engineering Installation Agency-Western Hemisphere (CEEIA-WE) at Fort Huachuca, Ariz.

Chief of the Special Systems Division, Office of the Deputy Chief of Staff for Plans and Operations, Strategic Communications Command (STRATCOM), until he assumed his new command, he has served as a Signal Corps officer and Army aviator in the Republic of Korea, in Vietnam and West Germany.

LTC Dehrkoop holds the Senior Army Aviator Badge, the Air Medal with six Oak Leaf Clusters, the second award of the Army Commendation Medal and the Meritorious Service Medal.

Former NASA Executive Joins MICOM

William A. Parker Jr., former chief, Procurement Division, National Aeronautics and Space Administration, Houston, Tex., is now deputy director of Procurement and Production, Army Missile Command.

Parker served 10 years with NASA in the Mercury, Gemini and Apollo programs until he joined the MICOM staff. He will direct 780 personnel who last year awarded and managed the production of almost $800 million in Army contracts.

William A. Parker Jr.

While at the Manned Spacecraft Center in Houston, Parker earned a master's degree in public administration from the University of Oklahoma. Currently completing work for a doctorate in political science, he is a member of the National Contract Management Association (NCMA), Society of Logistics Engineers (SOLE), and American Society of Public Administration (ASPA).

Awards . . .

APG Achievement Winners Honored

Aberdeen Proving Ground's Materiel Testing Directorate honored the winners of three top annual awards for achievements in research, development and testing at a ceremony in April, with MTD Director COL William P. Debrocke making the presentations.

Marlow D. Perrin, a project engineer in the Small Arms and Aircraft Weapons Branch with 22 years of federal service, was the recipient of the Director's Award. He was cited for "exceptional competence" in the design and modification of an ultra-light submachine gun system and ammunition components; also, design and fabrication of a 6-segment disintegrating caliber .45 bullet, and an infrared gun-fire detector.

Samuel F. Harley, formerly an enlisted specialist in the Instrument Development Section of the Technical Support Division of the MTD, was selected as the winner of the Crozier Award, memorializing MG William Crozier, 1901–1917 Chief of Ordnance. This honors the military MTD staff member who makes the most outstanding contribution each year.

Harley, who is now a civilian residing in Blacksburg, Va., was not present for the reading of the citation acknowledging his achievement in design and fabrication of instruments; also, a formal study of luminaries for use in solar radiation evaluation.

The citation also acclaimed his "mastery of the complex technical disciplines of electronic circuit design, optics, mathematics, radiation and the theory of logic control to accomplish the listed tasks.

Joseph B. Hodges, a proof technical leader in the Terminal Effects and Special Projects Branch, was honored with the Groak Award established in 1969 to honor the late George Groak, a former MTD employe who enhanced the claim of APG ordnance technicians as being "the best in the service."

Hodges was cited for his work in fragmentation testing of munitions, grenades, pyrotechnic items, antitank personnel mines, firing devices, demolition items, mine planters and dispensers, and drop tests of all types of ammunition tested at APG.

ABERDEEN PROVING GROUND Materiel Testing Director COL William P. DeBrocke presents Director's Award to Marlow D. Perrin. Joseph B. Hodges holds Groak Award he received. Samuel F. Harley, not shown, was winner of the Crozier Award.

Edgewood Employes Cited for Savings

Five Edgewood Arsenal employes credited with innovations responsible for estimated saving of more than $500,000 under the Army Cost Reduction Program were honored recently by COL George A. Lynn, arsenal commander.

Leo G. Appel of the Development and Engineering Directorate (DED) was cited for saving $260,000 in support equipment for a personnel detector.

Recipients of a joint award for saving $280,000 on the 105mm canister are John L. McNerney of DED, Mario W. Francioli, the Equal Employment Opportunity officer, Leonard F. Burke of the Manufacturing Technology Directorate, and George W. Hill, now retired.

The awards consisted of commendation plaques and letters of appreciation.

MERITORIOUS CIVILIAN SERVICE. *Walter W. Hollis,* the highest-ranking civilian employe at Fort Ord, Calif., recently received the Meritorious Civilian Service Award (MCSA), the Army's second highest award for civilian employes.

BG Ray Ochs, commander of the U.S. Army Combat Developments Experimentation Command at Fort Ord, presented Hollis the medal and a citation praising his service to the Army in the development of an experimental concept for Basic Attack Helicopter Experiments.

Charles H. Lebegern Jr., employed since 1950 at the U.S. Army Aberdeen Research and Development Center, Aberdeen Proving Ground, Md., was recently presented the MCSA.

ARDC Commander COL Rudolph A. Axelson commended him for significant contributions to standardization of artillery weapons and advancement of agreements ratified throughout the NATO structure.

As a member of the NATO delegation, he was cited for outstanding contributions to the Joint Services, and to the Joint Munitions Effectiveness Manual for Surface-to-Surface Munitions. In the course of these duties, he provided coordination to the interrelated efforts to the Army, Navy, Air Force, Marine Corps and the Coast Guard.

Lebegern, chief of the ARDC Firing Tables Branch, Ballistics Research Laboratory, is the U.S. representative to NATO as a member of the Army Armaments Group, and chairman of the NATO Methodology and Evaluation Working Group.

Dr. Benjamin Witten, chief of Edgewood Arsenal's Organic Chemistry Branch, received the MCSA for his role in conceiving and developing a binary chemical weapons system.

Dr. Witten was cited for opening a new field in chemical weapons technology with a system that establishes the practicality of generating a toxic agent from two nontoxic constituents. This is envisioned as a means of eliminating the hazards of producing, handling, transporting, and storing chemical munitions.

Edgewood Commander COL John K. Stoner presented the award consisting of a plaque and a medal with ribbon and Bronze Laurel Leaf Cluster.

Dr. Witten received his first MCSA in 1946 for his World War II research accomplishments at Edgewood, where he went to work in 1940 immediately after obtaining his doctorate degree in organic chemistry from Johns Hopkins University.

LEGION OF MERIT. *COL Donald H. Greeley* was awarded a second Oak Leaf Cluster (OLC) to the Legion of Merit (LM) upon his retirement from a 30-year military career. He retired after serving 2½ years as commanding officer of the U.S. Army Combat Developments Command Maintenance Agency (CDCMA) at Aberdeen Proving Ground, Md.

Deputy Chief of Staff for Logistics LTG Joseph M. Heiser acclaimed COL Greeley as "the world's greatest living logistician . . ."

COL Guy E. Jester, district engineer, St. Louis, Mo., was awarded the first OLC to the LM for meritorious service while he was assigned to the Office of the Chief of Research and Development, Department of the Army (1969–71).

MG Charles C. Noble, division engineer for the Lower Mississippi Valley Division (LMVD), Corps of Engineers, presented the award.

MAJ Thomas H. Huber, a staff officer in the Management and Evaluation Division of the Directorate of Plans and Programs, Office of the Chief of Research and Development, is a recent recipient of the LM and the DSM with 1st OLC.

Chief of Research and Development LTG William C. Gribble Jr. presented the award in recognition of MAJ Huber's service in Vietnam as director of the 29th General Support Group (1970–71).

LTC Donald L. Winters, staff officer with the Surveillance, Target Acquisition and Night Observation (STANO) Division of the Directorate of Developments, OCRD, was presented a second OLC to the Bronze Star Medal (BSM).

LTG William C. Gribble Jr. presented the award, which recognizes LTC Winters' service as commanding officer of the 129th Assault Helicopter Company in Vietnam during 1971.

MAJ James E. Turner, staff officer in the Life Sciences Division, Army Research Office, recently was honored with a second OLC to the BSM. LTG William C. Gribble Jr. presented the award in recognition of MAJ Turner's service as adviser with the Sector Management and Direct Support Logistics Center in the Mekong Delta, Vietnam.

MERITORIOUS SERVICE MEDAL. *LTC Frederick R. Dart,* communication and electronics representative with the U.S. Army Standardization Group, Canada, was recently awarded the first OLC to the Meritorious Service Medal (MSM) for his service as commander of the School Battalion, U.S. Army Signal School, Fort Gordon, Ga.

COL C. J. Molloy Jr., the senior standardization representative with the Standardization Group, presented the award at his office in Ottawa.

LTC Clyde Koen, project officer in the Project Control and Integration Directorate, U.S. Army Computer Systems Command, was awarded the MSM for service in Germany from March 1969 to September 1971. During this period he commanded Signal Service Battalion 4 and was later deputy commander of Signal Service Group 4. The award was presented at HQ Computer Systems Command, Fort Belvoir, Va.

LTC Dorothy R. Street, U.S. Army Medical Specialist Corps, has received the MSM for service during 1971 with the Manpower Group of the Resources Management Office, Office of the Surgeon General.

BG Louis J. Hackett Jr., special assistant to the Surgeon General for Resources Management, presented the award. In October 1971, LTC Street became the assistant chief of the Army Medical Specialist Corps and chief of the Occupational Therapy Section, OTSG.

MAJ Jerry L. Gregg, staff officer in the Life Sciences Division, Army Research Office, was awarded the MSM for his service as general sanitary engineering consultant, OTSG. Army Chief of R&D LTG William C. Gribble Jr. presented the award.

MAJ Donald B. Griggs received the first OLC to the MSM for his service as commander of the 379th Signal Battalion in Thailand during 1971. He is now a member of the Nuclear Team of the Nuclear, Chemical, Biological Division of the Directorate of Missiles and Space, OCRD. LTG William C. Gribble Jr. made the presentation.

COMMENDATION MEDAL. *SSG Walter P. Wagner Jr.,* now serving with the U.S. Army Engineer Power Group (USAEPG) at Fort Belvoir, Va., is a recent recipient of a first OLC to the Army Commendation Medal (ARCOM).

USAEPG Director COL Harvey L. Arnold Jr. presented the medal and a citation which recognized SSG Wagner's service as a maintenance supervisor with the 72d Engineer Detachment (Survey) in Monrovia, Liberia, during 1969-70.

MISCELLANEOUS AWARDS. The U.S. Army Mobility Equipment R&D Center (MERDC) recently presented Sustained Superior Performance Ratings and cash awards to: Mrs. Patricia A. Hahn, $200 for work as a technical data clerk in the Production Engineering Division; Norman W. Braun, $300 for solving engineering problems during quantity procurement of environmental control units; Joseph A. Vozzolo, $200 for his work in mine neutralization tests; and Bobbie W. Browning, $250 for his work as electrical engineering technician.

Other MERDC awards included: a $50 initial award to Roman Skujins for his invention of a fence tampering alarm for which a patent is pending; $25 each to Bernard W. Flynn and Vincent A. Lee for adopted safety suggestions; and $75 to Ronald L. Johnson for coauthoring and presenting a technical paper at the 17th Conference on the Design of Experiments in Army Research, Development, and Testing.

Also at Fort Belvoir, Va., Henry C. Gignilliat Jr., U.S. Army Engineer Power Group, received $300 with a Sustained Superior Performance Rating for his work as acting chief of the Nuclear Safety Analysis Team.

Peter Peterson, an electronic technician in the Land Combat Materiel Test Division at White Sands Missile Range, N. Mex., received $350 and a Certificate of Commendation for his invention and manufacture of a device to aid in the engineering and service tests of the Tactical Fire Direction System (TACFIRE).

Named the Digital Message Modifier (DMM), the device is considered essential for testing TACFIRE communications. The TACFIRE systems involves computerized procedures for solving field artillery fire control problems.

In addition to inventing the DMM, Peterson designed, developed and manufactured a digital coder unit using commercial micro-electronics parts which permits multiple recordings of digital (numerical) data to be made on a single recorder.

The use of this coding technique saves the expense of procuring several recorders, and since the design has a compatible input to the UNIVAC 1108 computer used at the range, the coder unit will save many tedious manhours in data reduction and analysis.

The award was based on the premise that his inventions will have extended application and eventually will result in significant improvements in the TACFIRE system.

Peterson has been employed at the Missile Range since 1957. Before his assignment to the TACFIRE program, he was associated with the Corporal, Sergeant and Pershing missile test and evaluation projects.

Deep Core Drilling Feat Gains Award

B. Lyle Hansen

One of the U.S. Army's epochal feats in probing for scientific knowledge about the cold regions dating back more than 30,000 years—by taking ice cores to depths of 4,560 feet in Greenland and 7,101 feet in Antarctica—has been honored by the International Glaciological Society.

The U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), an Army Corps of Engineers installation at Hanover, N.H., has announced that B. Lyle Hansen—who designed and developed the equipment for deep core drilling—is the recipient of the Seligman Crystal Award. Hansen is chief of the CRREL Technical Services Division.

The fourth presentation of this highly prestigious award was a highlight of the International Glaciological Society's annual conference in April in Cambridge, England. The award is made to scientists or engineers who have contributed uniquely to glaciology.

The ice cores provide clues, through sedimentary deposits, to what happened in the cold regions aeons ago—"secrets to cataclysmic evolutionary forces perfectly preserved." The ice cores in Antarctica, taken in 15-foot sections all the way down nearly 1½ miles to bedrock under the icecap, are now being studied by scientists.

Drilling near Byrd Station was started in 1966 and was continuous from Nov. 1, 1967 until completed Jan. 29, 1968. Recovery of ice cores exceeded 99.7 percent of footage drilled.

The CRREL drilling in Greenland and the Antarctic was sponsored by the National Science Foundation as part of the U.S. Antarctic Research Program.

BIOGRAPHY. Hansen received a BS degree in chemistry in 1940 at Brigham Young University and did graduate work at the University of Minnesota. He was with the U.S. Weather Bureau in Washington, D.C., from 1942 to 1947 as an instrument engineer and later as a physicist. He was physicist and director of the Central Sierra Snow Laboratory from 1947 to 1949, followed by two years as a research associate at the University of Minnesota.

In 1951, he became chief of the Technical Equipment Branch of the Snow, Ice, and Permafrost Research Establishment (SIPRE) of Wilmette, Ill., a predecessor organization of USACRREL. He has been with USACRREL since it was established in 1961.

AVSCOM Receives RCP Award

For its outstanding savings in the past Fiscal Year, the U.S. Army Aviation Systems Command (AVSCOM), St. Louis, Mo., recently received Resource Conservation Program FY71 unit award presented by the Army Materiel Command (AMC).

The AMC reported savings of $333 million to the Department of the Army for FY71, cited AVSCOM for saving $57.8 million, exceeding its goal by $11.7 million.

LTG W. W. Vaugan, AMC deputy CG, presented the award to MG Fred Kornet Jr., AVSCOM CG.

BRL Honors Fellowship Recipients

Newly established at the Ballistic Research Laboratories (BRL), U.S. Army Research and Development Center, Aberdeen (Md.) Proving Ground, is a program of BRL Fellowships, with 16 initial recipients honored at a recent ceremony.

Guest speaker Charles L. Poor, Deputy Assistant Secretary of the Army for Research and Development, traced the early history of the BRL, highlighting its contributions to the Army R&D community.

Selection as a BRL Fellow gives formal recognition to the importance of an individual scientist whose work at the laboratories is considered at the forefront of research.

The 16 new members, including five former Kent Award winners, were elected by a vote of the chiefs, director and associate director of various laboratories and divisions of BRL. Elections will be held in January of each year by the New BRL Fellows to select three outstanding professionals to membership.

Initial selectees are Richard H. Comer, Alexander S. Elder, Dr. Coy Glass, Luther M. Hardin, Dr. Norris J. Huffington, O. T. Johnson, George D. Kahl, Nathan Klein, Leonard C. MacAllister, Franklin E. Niles and Richard Vitali; also, Kent Award winners Harold Zancanata, Dr. Lester P. Kuhn, Arthur E. Thrailkill, Herman P. Gay and Dr. Ceslovas Masaitis.

RDT&E, Materiel Procurement Contracts Total $1.492 Billion

Army contracts for research, development, test, evaluation and procurement of materiel and services are compiled here for a 4-month period, due to omission of a report in the March-April edition. Only contracts exceeding $1 million are included and the total is $1,492,562,482.

Raytheon Co. received a $543,298,100 contract modification engineering development for the SAM-D Weapons System, and $71,307,456 for ground support equipment and engineering services on the Improved Hawk missile system.

The Peter Kiewit Sons Co. was awarded a $110,927,932 contract for construction of Safeguard Ballistic Missile Defense System Facilities.

Martin Marietta Corp. will be paid $38,125,000 for hardware and modification kits for the Pershing missile system.

The AM General Corp. received a $36,182,150 fixed-price with escalation contract for 5-ton trucks, M809 series. Two contracts to Textron, Inc. totaling $31,859,784 are for UH-1H utility helicopters.

Libby Welding Co., Inc. is receiving $14,761,473 as the first increment of a $23,079,207 3-year contract for manufacture of 15 kw and 30 kw generator sets.

Emerson Electric Co., is receiving $5,579,000 as the first-year increment under a $22,746,380 4-year contract for launcher equipment for TOW missiles.

Chamberlain Manufacturing Corp. was awarded a $22,340,165 contract for metal parts for 155mm projectiles, M107, Golden Industries, Inc., gained a $17,551,605 contract for 155mm projectile parts, and Sperry Rand Corp., received a $16,813,353 contract for 155mm projectiles.

Lear Siegler, Inc., was awarded a $15,000,000 contract for classified electronics and Bendix Corp. will be paid $13,700,000 for ST-120 stabilizing platforms and power control groups for the Pershing missile system.

Philco Ford Corp. is receiving a $2,120,200 initial increment under an $11,843,390 contract for the Shillelagh Product Improvement Program. National Presto Industries, Inc. was issued an $11,461,320 contract modification for 105mm projectile parts (M1), Etowah Manufacturing Co. Inc., $10,286,550 for M125A1 boosters for munition fuzes, and E. Walters & Co., Inc., $10,088,293 for point detonating fuzes, M48A3.

Contracts under $10 million. United Aircraft Corp., $9,962,201 for work on Advanced Blade Concept Technology Demonstrator Flight Research Program; Hughes Aircraft Co., $9,682,104 for TOW missiles; Radiation, Inc., $9,500,000 for classified electronic equipment; Aerojet Solid Propulsion Co., $366,000 as the first increment of a $9,420,000 5-year procurement for Hawk missile motors, XM112; and

AVCO Corp., $7,768,773 for work on T53-L-11 engine conversions; Maxson Electronics Corp., $7,680,297 for 81mm illuminating cartridges with time fuzes; Keystone Micro-Scan, Inc., $7,221,120 for point detonating fuzes, M48A3; General Dynamics Corp., $7,195,022 for work on the Redeye weapon system; Martin Marietta Corp., $7,021,350 for industrial engineering services for the Pershing; and

Western Electric Co., $6,920,518 for initial provisioning repair parts for the Safeguard Ballistic Missile Defense System; Teledyne Inc., $6,678,740 for AVDS1790-2A engine assemblies; AVCO Corp., $6,500,000 for classified R&D; Appalachian Power Co., $6,279,856 for operation of a power plant to support production requirements; and

The Mine Safety Appliances Co., $5,968,937 for filter elements; Raytheon Co., $5,992,000 for conversion of basic Hawk ground support equipment; Electrospace Corp., $5,771,212 for AN/PRC-77 radio sets and RT-841/PRC-77 receiver transmitters; Chamberlain Manufacturing Co., $5,512,794 for metal parts for 105mm projectiles; AM General Corp., $5,423,280 for 5-ton trucks, M809 series; Sperry Rand Corp., $5,342,269 for the purchase of rented UNIVAC 1108s installed at the White Sands (N. Mex.) Missile Range; Electrospace Corp., $5,099,301 for AN/PRC-77 radio sets and RT-841/PRC-77 transmitter-receivers; Gulf & Western Systems Industries, $5,073,107 for 105mm tracer projectiles; Martin Marietta Corp., $5,010,000 for motor cases for Sprint missiles.

Contracts under $5 million. Amron-Orlando Corp., $4,846,200 for point detonating fuzes, M551, for 40mm cartridges; Hughes Aircraft Co., $4,807,700 for M220E1 launchers for TOW missiles; Philco Ford Corp., $4,747,447 for FY 1972 engineering services in support of

WECOM Production Meets Heavy Procurement Orders

Requirements of a multi-million dollar procurement order for machineguns are keeping production pressure on the U.S. Army Weapons Command, headquartered at Rock Island, Ill.

Rock Island Arsenal commanding officer COL Paul E. Martin comments that "a great many engineering and production challenges must be met in order to turn out a quality weapon on time," but that the arsenal is "meeting the production schedules."

Involved in the task are the M85, 50-caliber machinegun and the M219 (formerly M73) 7.62mm weapon, both engineered for vehicular mounting. The M219 is primarily used mounted coaxially with the main armament on tanks, but has application on other armored vehicles.

Rock Island Arsenal fabricates the guns from raw forging to machining, to proof firing and packaging. COL Martin said some of the exacting requirements that must be adhered to in making the guns were more than private industry could handle successfully.

Rock Island's advantage in producing the guns is the ready availability of Weapons Command engineering for problem solution without the formal negotiation and modification involved in industrial contracts.

One of the advances in production is the use of electron beam welding to secure the M219's track in the receiver. This method replaces the old procedure of riveting and tack-welding the track in place. Electron beam welding gives the component longer life.

Other multi-million dollar orders being filled at the arsenal include tank gun mounts, self-propelled howitzer gun mounts, howitzers, modification kits for the Air Forces' B-52 bomber, and barrier bags for the U.S. Army.

WHAT'S NEW IN SLIDE RULES?

Believed unique in the world is slide rule shown here by Philip Zirkind, a nuclear physicist, who designed it with Kenneth Volet, a fellow employe at Picatinny Arsenal, Dover, N.J.

Photon radiation emitted from a nuclear blast can be computed rapidly with the aid of the rule. Given the temperature of the burst, it provides the total energy output of the weapon, and the type and amount of photons available at any point in space surrounding the burst. Thus it shortens time required to solve complex weapon design problems.

The slide rule is described in the manuscript for the latest of the U.S. Army Materiel Command Engineering Design Handbooks, titled DENEM for Design Engineers Nuclear Effects Manual.

Prepared under guidance of Daniel Waxler, chief of the Picatinny Arsenal Weapons Vulnerability Division, Nuclear Design Engineering Directorate, and members of his staff, DENEM will be a 4-volume compendium of the current state-of-the-art in weapon system design to survive the radiation effects of a nuclear burst.

DENEM will be distributed, when off the press, to selected Department of Defense agencies.

the Chaparral weapon system; Bowen, McLaughlin, York division of HARSCO, $4,707,000 for M578 recovery vehicles; LTV Aerospace Corp., $4,644,502 for continuation of engineering services for the Lance missile system; and

General Research Corp., $4,590,225 for studies on advanced development of ballistic missile defense systems and technologies; Martin Marietta Corp., $4,535,500 for R&D effort to provide an electro-optical simulation system; Marathon Le Tourneau, Inc., $4,460,200 for 750-pound bomb parts, M117A3; Honeywell, Inc., $4,437,000 for guidance and control systems for Minuteman III weapon system; and

Northrop Corp., $4,280,462 for engineering development of Variable Speed Training Target; AVCO Corp., $4,127,784 for T-53 engines for UH-1 helicopters; Honeywell, Inc., $4,116,254 for point detonating fuzes for 40mm cartridges; RCA Corp., $4,069,650 for AN/MPS-36 Mobile Instrumentation Radar; Martin Marietta Corp., $4,016,605 for work on an advanced guidance concept program; Gulf & Western Industries, $4,012,613 for warheads and motor body assemblies for 105mm Rocket Assist Projectiles, XM549; Sperry Rand Corp., $3,979,765 for purchase of rented UNIVAC 1108 computer systems; Rulon Co., $3,911,947 for delay plungers, M1; Norris Industries, Inc., $3,896,363 for 105mm cartridge cases, M14B4; LTV Electrosystems, Inc., $3,837,381 for receiver transmitters; and

REDM Corp., $3,775,015 for head assemblies, T336E7, for fuzes; Bulova Watch Co., $3,762,300 for point detonating fuzes for 81mm projectiles; Walter Kidde Co., Inc., $3,720,000 for point detonating fuzes, M48A3; Bulova Watch Co., $3,681,000 for head assemblies for munition fuzes; Keystone Micro-Scan, Inc., $3,610,560 for point detonating fuze parts, M48A3; Eureka-Williams Co., $3,583,140 for bomb fuzes, M904E3; and

Action Manufacturing Co., $3,533,881 for 81mm projectile fuzes; Eureka-Williams Co., $3,435,520 for bomb fuzes, M904E3; Beech Aircraft Corp., $3,334,220 for engineering development of a Variable Speed Training Target; Stewart Warner Co., $3,324,420 for 60mm high-explosive projectiles, M49A3; McDonnell Douglas Corp., $3,314,983 for 47 first-stage and 49 second-stage Spartan missile nozzles; and

GTE Sylvania, Inc., $3,324,000 for classified electronics; Cornell Aeronautical Labs, $3,269,424 for evaluation of techniques to discriminate among threatening objects in a ballistic missile attack, and a study to develop advanced interceptor technology and homing techniques; Textron, Inc., $3,267,523 for repair of 80 crash-damaged and high-time UH-1 and AH-1 helicopters; Pacific Car & Foundry Co., $3,217,178 for an advance engineering study to update technical data for Universal Tractor and four test models; HITCO, Chaparral Industries Division, $3,167,760 for nozzle and fin assemblies for 2.75-inch rocket motors; and

Athey Products Corp., $3,137,711 for lift trucks; Teledyne, Inc., $3,116,620 for engineering services for the 1790 series engine, AVDS; Hughes Aircraft Corp., $3,079,896 for TOW missiles; Sperry Rand Corp., $3,025,000 for production of ordnance alteration kits for the AN/SPG-55B surface radar fire control system; AMBAC Industries, $3,014,827 for 60mm illuminating cartridges; LTV Electro Systems, Inc., $2,912,322 for RT-524A/VRC receiver-transmitters and R-442A/VRC receivers; AVCO Economic Systems Corp., $2,859,306 for the manufacture of munition components and renovation of ammunition cans; and

Bristol Electronics, Inc., $2,793,810 for AN/PRC-25 radio sets; Hercules, Inc., $2,780,000 for the manufacture of ignitors and motor loading of Sprint missiles; Airport Machining Co., $2,672,002 for 60mm high-explosive projectiles, M49A3; Norris Industries, Inc., $2,493,623 for 105mm cartridges; General Motors Corp., $2,488,022 for diesel engines for M113A1 vehicle series; Westinghouse Electric Corp., $2,488,000 for a Mobile Miss Distance Indicator Radar System; Olin Corp., $2,477,032 for brass case cups for small arms ammunition; and

Wilkenson Manufacturing Co., $2,400,004 for point detonating fuzes for 81mm projectiles; Chrysler Outboard Corp., $2,302,967 for general-purpose military standard engines; Grismac Corp., $2,346,485 for M2A1 ammunition boxes; Martin Marietta Corp., $2,300,000, and Texas Instruments, Inc., $2,300,000 for advanced development of a cannon-launched guided projectile; Philco Ford Corp., $2,298,783 for engineering and installing a telecommunications system in the Federal Republic of Germany; and

General Electric Co., $2,282,475 for transceivers, accessory equipment and advisory services for the Imperial Iranian Gendarmerie; Cooper Bessemer Co., $2,276,436 for diesel engine generators for the Safeguard system; Singer Co., $2,244,837 for hydraulic actuators for Pershing missiles; AVCO Corp., $2,240,000 for the overhaul and modification of 320 helicopter engines; Control Data Corp., $2,216,460 for the purchase of installed rented computer equipment at the Army Mobility Equipment R&D Center; and

ESB, Inc., $2,213,844 for radio batteries and for testing and technical data; Consolidated Box Co., Inc., $2,125,779 for fiber containers for 105mm cartridges; The Intercontinental Manufacturing Co., $2,081,109 for Spartan missile motor cases; Mine Safety Appliances Co., $2,039,264 for 732,899 sets of long-lead-time materials and supporting special tooling for the filter element for protective masks, M17A1; and

Raytheon Co., $2,028,221 for engineering services for improved Hawk missile system; Maxson Electronics Corp., $2,026,953 for loading and assembling 60mm illuminating cartridges, M83A3 and M65A1 fuzes; Keystone Micro-Scan, Inc., $2,002,143 for munition fuze parts; M48A3; Martin Marietta Corp., $2,000,000 for additional effort in continuation of the Sprint II missile subsystem advanced design; System Development Corp., $1,933,256 for a data processing test center at Huntsville, Ala.; and

Rulon Co., $1,932,000 for parts for munition fuzes M48A3; Philco Ford Corp., $1,924,777 for installation of an overseas automatic switching center at Fort Detrick, Md.; United Ammunition Container Co., Inc., $1,883,887 for fiber containers for 105mm cartridges; Bulova Watch Co., $1,881,150 for M524A6 fuzes for 81mm projectiles; Martin Electronics, Inc., $1,878,927 for colored smoke hand grenades; Walter Kidde & Co., Inc., $1,860,000 for 105mm projectile fuze parts; Firestone Tire & Rubber Co., $1,858,663 for 74 inflatable shelters and 2 corridor connectors for Medical Units, Self-contained; and

Aerojet Solid Propulsion Co., $1,847,820 for loading of rocket motors for Hawk missiles; Bulova Watch Co., $1,839,375 for T-336-E7 head assemblies for munitions fuze PDM525; General Electric Co., $1,835,580 for M61A1 20mm automatic guns; Chamberlain Manufacturing Co., $1,825,502 for 81mm high-explosive projectile parts, M374A1; Norris Industries, Inc., $1,825,502 for 81 mm projectile parts, M374A1; and

D.C. Electronics, Inc., $1,789,959 for 70,776 light kits for trucks and trailers; Raytheon Co., $1,787,811 for repairing/rebuilding components of the Improved Hawk missile system; Centron Corp., $1,772,896 for fiber containers for 105mm cartridges; I.D. Precision Components Corp., $1,763,520 for M524A6 fuzes for 81mm projectiles; and

Black & Veatch, $1,745,541 for continuation of architect engineer services for the preparation of standard plans and specifications for the Safeguard missile site radar and perimeter acquisition radar power plants; and

General Dynamics Corp., $1,736,000 for a range measurement system for Maverick tracking and data collection; Fairchild Industries, Inc., $1,721,570 for furnishing and installing control system and monitoring equipment for the Safeguard system; Etowah Manufacturing Co., $1,700,907 for booster assemblies for detonator futes; Goodyear Tire & Rubber Co., $1,697,624 for track shoe assemblies for M113 personnel carriers; and

Pace Co., $1,686,085 for white star parachute illuminating signals, M127A1; National Forge Co., $1,670,550 for gun tube forgings for 155mm howitzers; Hughes Aircraft Co., $1,635,000 for integrated night thermal site turrets for combat vehicles; Magnavox Co., $1,631,300 for 357 radio sets, AN/ARC-131; Goodyear Tire & Rubber Co., $1,610,294 for 62,560 track shoe assemblies for M41 tanks; System Development Corp., $1,595,170 for inter-service systems research program for computer-assisted planning; and

AVCO Corp., $1,554,842 for nozzle turbines for T-53 gas turbine engines; Electromagnetic Technology Corp., $1,539,417 for spare parts for AN/VPS-2 radar sets for 20mm Vulcan guns; Progress Aerospace Enterprises, $1,539,023 for 8 Redeye moving target simulators, M87; Aerojet Solid Propulsion Co., $1,525,000 for rocket motors for 2.75-inch rockets; AVCO Corp., $1,520,000 for 1972 product improvement program for T-53 series engines; and

AVCO Corp., $1,518,685 for product improvement program for T55 gas turbine engines; Security Signals, Inc., $1,510,747 for M503A2 point detonating fuzes; Motorola, Inc., $1,500,000 for classified electronics; Tasker, Inc., $1,499,173 for 81mm illuminating cartridges, M301A3 with M84A1 fuzes; RCA Corp., $1,498,252 for FY 1972 Land Combat Support Systems research and development program; White Engines, Inc., $1,486,597 for 28,049 sleeve cylinders and piston assemblies; COMTEC Laboratories, Inc., $1,484,400 for kits to update SATCOM terminals; and

International Harvester Co., $1,477,317 for 105 tractor trucks; Thiokol Chemical Corp., $1,449,743 for engineering services in preparation for motor loading and ignitor manufacture for the Spartan weapon system; AVCO

(Continued on page 44)

RDT&E Contracts Total $1.492 Billion

(Continued from page 43)

Corp., $1,414,979 for body assemblies for 40mm projectile parts; FMC Corp., $1,366,259 for design and fabrication of a component transfer system for the manufacture of 5.56mm ammunition; and

Norris Industries, $1,328,040 for 105mm high-explosive tracer projectiles; Hughes Aircraft Co., $1,323,000 for fabrication and installation of modification kits for AN/MSC46 satellite communication terminals; Western Electric Co., $1,300,00 for FY 1972 Nike-Hercules engineering services; Westinghouse Electric Corp., $1,285,692 for balanced pressure sensory systems; Security Signals, Inc., $1,280,436 for body assemblies for point detonating fuzes, M525; Goodyear Tire & Rubber Co., $1,253,151 for track shoe assemblies for M41 combat tanks; and

Action Manufacturing Co., $1,248,339 for tail fuzes, M905, for 750-pound bombs; Clymer Machine Co., Inc., $1,240,000 for body assemblies for fuzes, TDM525; AMBAC Industries, Inc., $1,226,112 for 618,00 trip surface flares; Clymer Machine Co., $1,211,249 for body assemblies for M525 fuzes for 60mm mortar projectiles; and

IPSCO Fabricators, $1,199,016 for launch tubes for Sprint missiles; Philco Ford Corp., $1,188,417 for acquisition, testing and demonstration of a Real Time Exo-atmospheric Target Designator for the Advanced Ballistic Missile Defense Agency; and

Textron, Inc., $1,172,954 for work on the flight control system qualification for UH-1N helicopters; Security Signals, Inc., $1,170,000 for body assemblies for TDM525 fuzes; Ammann & Whitney, $1,159,651 for continuation of architect engineer services for the preparation of standard plans and specifications for the Safeguard Perimeter Acquisition Radar and site adaption of the design to the first Safeguard site in the vicinity of Grand Forks, N.D.; and

LTV Aerospace Corp., $1,500,000 for R&D for Phase II, hardware refinement, fabrication, and pre-flight support for the warhead terminal guidance demonstration program; Poloron Products, Inc., $1,188,070 for 24,500 M-548 20mm containers; General Motors Corp., $1,177,368 for batteries; Teledyne, Inc., $1,139,549 for the development of components, electronics and technology in optics for the Army Ballistic Missile Defense Agency;

Baldwin Electronics, Inc., $1,135,301 for loading, assembling and packing of 2.75-inch rocket motors; Norris Industries, Inc., $1,119,409 for 105mm cartridge cases; LaBarge, Inc., $1,090,525 for disposable seismic intrusion detector units; Oregon Metallurgical Corp., $1,088,885 for 153 jet vane assemblies for Pershing missiles; United Aircraft Corp., $1,088,000 for R&D of a fan-in-fin anti-torque and directional control system; and

Chamberlain Manufacturing Co., $1,087,898 for 155mm projectiles; Wilkinson Manufacturing Co., $1,086,645 for point detonating fuze parts, M524A6; McDonnell Douglas Corp., $1,073,547 for R&D for the modified Spartan preflight demonstration program; LTV Electronics Inc., $1,073,317 for a counter-measures set; Airport Machining Corp., $1,068,000 for 2.75-inch rocket warhead parts, M156; Olin Corp., $1,063,994 for 24,303,200 M41 ball cartridges; and

Stanford Research Institute, $1,063,763 for continuation of research scientific studies and evaluations relating to strategic forces posture analyses requirements of the Department of the Army; Aerojet Solid Propulsion Co., $1,051,183 for Hawk missile motors; Wittronics Manufacturing Co., $1,047,376 for M509A1 fuzes for 105mm cartridges; and

Bolt, Beranck & Newman, Inc., $1,016,652 for continuation of research, installation, operation and maintenance of multiple-node network message processors for the ARPA Computer Network; Honeywell, Inc., $1,011,035 for low-level conversion kits for teletypewriters; Western Electric Co., $1,008,789 for engineering change procedure on integrated circuit packages; and Lockheed Aircraft Corp., $1,000,000 for support of Combat Developments Command, Experimentation Command experiment 43.6, phase IV.

NSF Awards HumRRO Continued Research Grant

The National Science Foundation (NSF) has awarded the Human Resources Research Organization (HumRRO) a grant of $179,100 to continue work for a third year on a project identified as "Research on Instructional Decision Models." The extension raises the total to $483,000.

An Instructional Decision Model (IDM), in the context of HumRRO research on computer-administered instruction, is a set of rules for matching the computer presentation of specific subject matter and questions with student capabilities.

Researchers will test a series of IDM versions with special attention to such factors as: general pre-course student history, specific student entry characteristics, mapping of the structure of subject matter, and within-course student experience/history. Each subsequent refinement of IDM will have the empirical feedback from preceding iterations contributing to further development.

contracts

HumRRO Publishes FAA Study Reports

Two HumRRO reports have been published on the results of a project sponsored by the Federal Aviation Administration concerning training program improvement.

They are: "A Study of Training Improvements; Vol. I: Findings and Analysis" (February 1972); and "A Study of Training Improvements; Vol. II: Recommendations for Improvement" (February 1972).

TECOM Effects Changes In Staffing, Organization

Major changes in the staffing and organization of HQ U.S. Army Test and Evaluation Command were effected in April.

Reorganization was accomplished within existing resources to enhance the command's testing capability. Expertise will be developed in the technical areas of operations research, systems analysis, and human factors engineering.

The basic restructuring includes establishment of a deputy chief of staff for analysis and six functional staff elements reporting directly to him, namely: Systems Analysis Directorate; Reliability, Availability, and Maintainability Directorate; Human Factors Engineering Directorate; Methodology Improvement Directorate; Instrumentation Directorate; and the Plans and Study Programs Office.

The Plans and Analysis Directorate was abolished and the materiel testing directorates were regrouped with the Test Operations Directorate.

COL Henry F. Grimm Jr., deputy chief of staff for test and evaluation since May 1970, is assigned to the newly created post of deputy chief of staff for analysis. COL Lewington S. Ponder, former director of Infantry materiel testing, succeeds him as DCS for T&E.

COL George T. Morris Jr., new assistant deputy chief of staff for analysis, headed the Plans and Analysis Directorate since joining the headquarters in August 1970.

Big Contract Initiates Work On Minuteman Demonstration

Award of a $382 million contract, announced by Secretary of the Army Robert F. Froelke, calls for work on the protytype demonstration program for site defense of the Minuteman (SDM).

McDonnel-Douglas, prime contractor for the project, has selected Control Data Corp. as data processing supplier at a cost of $30 million. The contract to McDonnel-Douglas extends work for a 60-month period.

The data processing equipment included in the proposal to the Army for the prototype demonstration program includes the CDC CYBER 70 models 73, 76 and 77 (a dual configuration of Model 76s) general-purpose computer systems.

AVSCOM Announces Engine Award

Delivery of four 8,000-shaft-horsepower engines for the Army's Heavy Lift Helicopter (HLH) Advanced Technology Component Program is scheduled under a $15.5 million development contract modification.

The U.S. Army Aviation Systems Command, St. Louis, Mo., announced award of the contract to the Boeing Co. As a result of competitive solicitation and evaluation, the Boeing Co. has selected the Detroit Diesel Allison Division of General Motors, Indianapolis, Ind., as subcontractor for development of the engine, designated the 501-M62B.

Reader's Guide . . .

DDC Computerizes Reference System

Adoption of a computerized reference system for use by the 2,800 agencies having access to the Defense Documentation Center's science and technology data bank is a recent innovation at the Cameron Station, Va., installation.

Pioneered by the Army Electronics Command (ECOM), the Selective Dissemination of Information (SDI) system enables scientists, engineers and technicians to keep informed of the latest technical publications that may be of value in their work. SDI saves countless hours of manual searching of the literature in the nation's technical libraries.

SDI matches the individual scientist's specific areas of interest, or profile of subject terms, against subjects listed in a semimonthly DDC accession computer tape, each averaging some 2,000 new titles. The DDC lists over 7,300 descriptors incorporated in its tape collection.

Matching of the tapes is done at HQ ECOM or any of the 2,800 subscribing agencies, providing the agency has the proper computer facilities for linking to the SDI system. The average ECOM subscriber will order full copies of about 10 percent of the cited documents.

A computer printout booklet is sent semimonthly to individual ECOM subscribers. Consisting of selected abstract listings of documents pertinent to the subscriber, its cover serves as a return document order sheet.

Each subscriber's security status is cleared by the computer to prevent unauthorized issuance of material. ECOM initiated the use of accession tapes in 1966, and the following year perfected the computerized system now adopted nationwide by the DDC.

The DDC collects and indexes technical documents for Defense Department use, and is one of the world's largest collection points for science and technology reports.

ECOM automated data processing officials estimate that half of the documents referred to a scientist will be of direct value and that most of the remainder will prove of general interest.

The ECOM SDI system is under the management of Darvey W. Wixon, chief of the STINFO Branch, Directorate of Management Information Services. Howard M. Cutler and Joseph Tully of the Systems Design, Programing and Integration Division, DMI , are credited with development of the computer program.

Newsmagazine Bids for Contributions

With this edition of the *Army Research and Development Newsmagazine,* the irregularity in issuance during the past year, attributable to a combination of staffing and other problems, is scheduled to end.

Starting with the July edition, the editorial staff will return to regular monthly editions, a schedule that was pridefully maintained during the first decade of publication, except for selective special editions.

The current "freeze" on filling editorial staff vacancies means that our three staff writers will need a big assist from contributors of bylined articles, and from information officers at all echelons.

Only with a substantial increase in the flow of high-quality reports on significant work from field agencies will production of monthly editions be feasible. Needed particularly are illustrations that will show R&D activities at their best—quality pictures that will have maximum eye appeal.

Our plan calls for a "center-spread" feature article each month that is particularly noteworthy—an article supported by color pictures similar in visual impact to those used for front and back covers of recent editions.

Information officers or other contributors of material who believe they can produce feature articles and pictures of acceptable merit are asked to discuss their ideas in advance of submission of material. Please call our editorial office—telephone numbers OXford 27338 or 27339 or 21480, or the Autovon equivalent of these numbers. Advance calls will assist greatly in scheduling material for publication.

Material normally should be submitted at least seven weeks in advance of the month of publication—meaning that feature articles intended for the August edition should be received in our office between June 1 and 10.

In the case of timely news items, the editorial staff will try to handle them until shortly before press time, the 10th of each month for publication the next month—but submission earlier will improve the odds for acceptance.

Radar Spelled Backwards . . . by Zahl

Radar Spelled Backwards, recently published sequel to *Electrons Away,* reflects again that when Dr. Harold A. Zahl embarked in 1931 on a 35-year career as an Army scientist, he did it with appreciation for humor of the rollicking variety.

Electrons Away or *Tales of a Government Scientist* was characteristic of Dr. Zahl's compulsion to stir belly laughs of block-buster proportions, meanwhile tossing in a bit of mystery and intrigue for side effects. In recent years, since his retirement, this blend has gained publication of numerous articles in magazines.

Radar Spelled Backwards, published by Vantage Press of New York at $4.50, takes much the same approach to reader appeal. It is notable also for an interesting foreword by Donald G. Fink, whose reputation as a scientist and an Army Scientific Advisory Panel member or consultant since 1957 is well-known to the Defense R&D community. He is general manager of the Institute of Electrical and Electronic Engineers.

You can read *Radar Spelled Backwards* for laughs. But you will be more richly and lastingly rewarded if you consider it on its proper merit as a book that provides an encompassing view into the beginning and the development of radio, radar and the marvels of modern electronics.

Known as the inventor of the Zahl tube, credited with a significant part in the evolution of electronics, the author is exceptionally well-informed regarding that process in the fascinating and sometimes bizarre story he tells.

BSRL Reports on Officer Research

"Psychological Factors Measured in the Differential Officer Battery," a technical report of research on identification and development of officer leadership conducted by the Behavior and Systems Research Laboratory, has been released for distribution.

Identified as Technical Research Report 1173, this 27-page summary with correlating tables describes in detail a comprehensive research program for early identification and career development of Army officer leaders.

Conducted in several phases, the program included a series of psychological tests constituting a broad sampling of abilities, knowledge, opinions, self-report data, and physical performance.

This particular report deals with analysis of officer responses on those tests, primarily to identify the psychological factors measured.

Copies are available at: U.S. Army Behavior and Systems Research Laboratory, Attn: RDMR-BL, 1300 Wilson Blvd., Arlington, Va. 22209.

Defense Publications Consolidated

The April edition of the *Defense Management Journal* is the first which absorbs the former *Defense Industry Bulletin.* Consolidation was directed by the Assistant Secretary of Defense (Installations and Logistics) to reduce periodical costs.

The journal's former distribution list, compiled and maintained under The Adjutant General's Pinpoint Distribution System, is the basic mailing list for the merged publication. Those who did not formerly receive the journal are required to fill out a DA Form 12–4 and submit it through normal publication supply channels to be put on distribution.

NRC Serving as 'Information Desk'

The Library of Congress National Referral Center (NRC) can be used by individuals or organizations working in any field of the physical, biological, social, and engineering sciences.

Serving as an "information desk," the NRC constitutes a single source for advice on locating specific scientific and technological information. Technical details or bibliographies are not provided but the NRC gives requestors the names and addresses of organizations and individuals having specialized knowledge in particular subject areas.

The address: Library of Congress, Science and Technology Division, National Referral Center, 10 First St., S.E., Washington, D.C. 20540.

Speaking on . . .

The Metric System in World Trade

(Continued from inside front cover)

game in some quarters. The Japanese and Germans have made great use of the scientific and engineering literature being generated in the United States. With a level of effort in research and development that is impressive, but less than ours, they have been able to transfer new knowledge into industrial production and capture ever larger portions of the world market.

"We, at the Department of Commerce, hope to take a hard look at new ways to help U.S. industries enhance productivity and competitiveness on a broad front.

"The President proposed in his 1973 budget message to Congress that NBS establish an Experimental Technology Development and Applications Incentives Program to investigate—by actual experience in cooperation with the private sector—the usefulness of a variety of incentives and mechanisms to stimulate the generation and application of private research and development in ways that will make our economy more competitive, improve its productivity, and provide new technological solutions to national problems.

"When one looks to foreign experience, one cannot help being impressed at the variety and extent of programs of government assistance for the development of technology in the private sector. Most of these programs are directed at export trade expansion and productivity improvement. Canada, Japan, Germany, and the United Kingdom all have such programs. But one cannot assume that any of them would be appropriate for the U.S.

"One very important feature of the proposed NBS experimental program is the reliance to be placed on the initiatives of the private sector in identifying mechanisms and experiments that should be undertaken. We in government do not have all the answers.

"We believe that the profit motive is still the best incentive for private sector R&D. Thus we will look for cost-sharing programs, where the commitment of the company or industry gives confidence that the technology will find its way to the marketplace, and that something of permanent value for the country can result.

"Thus we do not intend to stimulate research as an end in itself, but as a means to the end. Mechanisms will be explored that recognize proprietary interests as a motivating force to move innovations to the market.

"As the possible experiments with innovation are defined, we would provide an opportunity for public review and comment. Thereby we would seek to ensure that they are soundly conceived and that any questions about the impact of any given project on the competitive position of companies within an industry are raised and resolved in advance.

"While funds for this new experimental program are yet to be approved by the Congress, we are very eager to receive the views of industry and the export segment of the economy in particular about how such a program might be helpful. We intend to look at areas which might include market aggregation, or joint government-industry development activities or programs to better exploit government-held patents to improve America's industrial productivity. And we hope that, as we help identify mechanisms for surmounting the barriers to private sector R&D incentives, the government can be more effective in its efforts to strengthen America's competitiveness.

"The program I have been describing is intended to teach us something about economic enhancement in the near future. But let us step a few paces back from the canvas and look at America from the perspective of the third century, beginning in 1976.

"Granted that the government's primary obligation is to help create the environment with which the private sector can make free enterprise work for the people, what about the measurement environment for America's third century?

"Since George Washington asked Congress to pay attention to the fixing of our standards of weights and measures in his first inaugural address, Americans have argued about the measurement system best suited to our needs.

"Much foolishness on both sides of the case has accompanied the debate over 200 years. But today we can see the issue in more practical, hard-headed terms.

"Our ability to produce the necessities and luxuries of life and pay wages at a high living standard depends on our ability to mass produce products for a large market. The economy of producing large numbers of items for sale to over 200 million people is basic to our standard of living.

"Other countries are recognizing this fact. The nations of the European Free Trade Association are trying to put together a market of 265 million people—a market larger than that of the United States.

"To do so, they find they must harmonize their engineering standards. They must, in fact, speak the same measurement language—the metric system, or more correctly the International System (IS) of units. They must harmonize these units of measurement and this language so that they may exchange goods freely across their borders, so that products and components made in different countries are compatible and integral, so that technicians may work with the same set of tools.

"The Japanese, too, have joined this growing international language group. Their products are based on metric units. In fact, all of the other world industrial powers have declared their intent to consciously and swiftly convert to the use of metric units. Great Britain and Canada, among the last of the big-power hold-outs, have already made commitments to go metric.

"Granted, going metric won't solve the problems of world trade. But the longer we wait, the more schizophrenic our problems will be as we work to maintain our economic competitiveness. In world trade, standards are important mainly in 'measurement-sensitive' products, those in which dimensions are critical; like tractors, clinical thermometers, vacuum pumps, typewriters, computers.

"In 1969 the United States exported about $14 billion worth of measurement-sensitive products and imported about $6 billion worth. The difference, $8 billion, was considerably more than the nation's favorable balance of trade, which was only $1.3 billion that year. (It was $2.7 billion in 1970.)

"Standards-based agreements could be a non-tariff barrier against our exports. A relatively slight drop in our exports of measurement-sensitive products could mean the difference between a favorable and an unfavorable U.S. trade balance.

"Thus far the effect of world standards developments seems to be slight. The U.S. Metric Study asked exporters of measurement-sensitive products for their views about factors influencing their trade. Differences in measurement systems and standards seemed relatively unimportant compared to reliability, reputation, price, superior technology, and high quality of product.

"Nevertheless, in their opinion, being metric today would increase 1975 exports by $600 million, with a negligible increase in imports. Apparently, the metric question is not a major factor affecting the absolute amount of U.S. trade. The U.S. still is the leading exporter in the Free World.

"But there are indications that America's share of the world market is diminishing. This is partly because Western European nations have been steadily lowering barriers of trade among themselves. These barriers will become still lower as national differences in engineering standards are ironed out. But their efforts to adopt a unified measurement system will surely tend to reduce the U.S. share in trade in that highly aggregated market, as well as in those metric nations with which they trade.

"Thus, the United States becomes the last large industrialized nation to have no policy to adopt the metric system. Yet, if we are to have most effective access to this world market, we must look at our customary standards and procedures and see how they mesh or clash with the accustomed procedures of other na-

. . . "Most nations dependent on world trade, via new or improved products resulting from research and development, have already converted to the metric system."

tions. We must carefully consider the prospects and the problems of going metric.

"Here, let me pause to dispose of the idea that the metric system of measurement is something foreign to this country. It is as firmly woven into our national fabric as our customary system of measurement. In 1866 Congress passed a law making it legal to use the metric system in trade and commerce. It reads in part as follows:

'It shall be lawful throughout the United States of America to employ the weights and measures of the metric system; and no contract or dealing, or pleading in any court, shall be deemed invalid or liable to objection because the weights or measures expressed or referred therein are weights or measures of the metric system.'

"The metric system is the only system explicitly legally recognized by the federal government, even though it is less used. The customary system of inches and pounds has never been similarly recognized, except at state level, simply because it never seemed necessary.

"Certain of our industries—pharmaceuticals and ball bearings—have already switched to metric measure for their own convenience and efficiency. But across American industry a measurement schizophrenia is apparent.

"The width of photographic films is given in millimeters, but the distance between the film's sprocket holes is given in fractions of an inch. Spark plug threads are metric, but the plug heads and wrenches are specified in inches. Use of the metric system in this country is increasing all the time. The new Ford Pinto engine is now completely metric.

"There are two dimensions to the idea of going metric. In many circles there is confusion between the two—the measurement language, and engineering practice and design. The idea of measurement language is simple and fairly well understood. We are accustomed to measurements like the inch, which is based on the length of the knuckle of the thumb, and the yard, which was the distance from King Edgar's nose to the tip of the middle finger of his outstretched arm.

"The meter was based on a measure equal to one ten-millionth of the quadrant of the earth measured over the meridian between Dunkirk and Barcelona. Today each of these units is inadequate. Everyone's thumb is slightly different. King Edgar is no longer with us. And modern science has found that the earth's circumference is not what the French National Assembly of 1790 had thought.

"Today we define the second in terms of the natural frequency of cesium atoms and the meter in terms of the wavelength of light given off by krypton atoms. (The housewife can rest easy knowing a liter is approximately a quart, a meter is slightly more than a yard, and a kilogram is slightly more than two pounds.)

"Engineering practices and standards are a different thing entirely. They involve the arbitrary sizes, shapes and configurations in which we choose to make our goods. They derive from attempts to simplify design and to use even numbers. Thus, common nails could be made in an infinite variety of lengths. Common sense tells us we do not need all those sizes, so we will select a certain few nicely spaced sizes and make only those.

"Industry has been carrying on the practice of standardization for many years, which is beneficial to both manufacturer and consumer. At the turn of the century light bulbs were made in a bizarre number of base size and bulb configurations. Industry, through voluntary standardization, reduced the number of different bulbs manufactured.

"In so doing they simplified their manufacturing procedures, simplified the consumer's shopping, and reduced the price of light bulbs dramatically. So this process of setting arbitrary engineering standards for sizes, configurations and practices is a normal and beneficial industrial practice.

"Industries in metric countries tend to standardize sizes in even numbers of metric units. American industry chooses to make a fitting which is two inches in diameter where an industry in a metric country might prefer five centimeters. The two resulting parts would be tantalizingly close in size, but completely incompatible.

"Obviously, if we change our measurement language we must consider what, if any, changes are needed in pipe sizes, construction materials, automotive parts, or the standard heights of ceilings. Pipe sizes differ in the U.S. and Europe. We each name our range of sizes by certain standard metric or English dimensions. However, our standard pipes nowhere measure to the dimensions used as their names. Thus, ⅛-inch water pipe nowhere measures ⅛ of an inch; this is simply a convenient name.

"In addition, we tend to relate our pipe size names to the inside dimensions while the Europeans work from the outside dimensions. In contrast, consider the letter and number drills. These drills are used on both sides of the Atlantic. Their diameters are measures with 4-digit decimal numbers, whether given in inches or in millimeters. Thus, one may say that they are either both metric and English or neither. No incompatibility results from a change in measurement language for such objects.

"But the problems of international harmonization are not alone a function of measurement practice. We speak the same measurement language as Europe in electrical practice. Yet, they have elected to use 50-cycle, 220-volt current to run their appliances while we have 60-cycle, 120-volts for ours. And to make sure we don't ruin imported equipment we shape our electrical plugs differently.

"So differences in practice are not alone produced by differences in measurement language—though we must remember that they are at least partly produced by differences in measurement language.

"It would be a grave mistake to think that we must totally give up our accepted engineering standards in order to deal with metric countries. First, many U.S. engineering standards are so technically superior to those of other nations that they are used abroad even though they may not be formally adopted as national standards of those countries.

"In addition, there are established procedures for nations to get together and write engineering standards acceptable to all. In these deliberations, through the International Organization for Standardization (IOS) or the International Electrotechnical Commission (IEC), we have every reason to expect that our technology will receive the recognition it is due if we participate vigorously in the negotiations.

"What this new legislation means, of course, is that the United States actively and formally would adopt the base standards which are used in other nations, converting from a system of measures which we, almost alone, now use.

"Today there are only about 2,500 international standards which have been adopted by IEC and IOS, nongovernmental bodies in which some 65 countries participate at the private sector level. A modern nation needs somewhere between 20,000 and 30,000 standards to function effectively.

"Today we live on our national standards. We don't depend upon the international standards. But as the other industrial powers eat into the marketplace, both here and abroad, this activity will exponentiate.

"In the next 10 years some 10,000 international standards may be recommended and adopted by those other nations. If the United States stands by while other nations use IOS as their vehicle for eliminating the nontariff barriers to the foreign market, if we stand by while they write their industrial technology into what will be a package of at least 10,000 metric industrial standards, then the process of going metric will mean to convert to foreign industrial practice.

"If, instead, we get in there in the next 10 years and get our

(Continued on page 48)

Speaking on . . .

(Continued from page 47)

technology written into those international standards, those other nations will have to change to our technology at least as often as we do to theirs. This is the major source of urgency toward getting started with developing U.S. national metric standards.

"The NBS study, 'A Metric America—A Decision Whose Time Has Come,' upon which Secretary of Commerce Stans based his recommendations to Congress and which sparked the current legislation, showed that U.S. participation in international standards deliberations is hardly enthusiastic. If we are effective in getting international agreements on standards based on superior U.S. technology, metrication will be easier for American industry.

"The international standards report considered this such a severe problem that it made specific recommendations to strengthen the contributions of both American industry and American government to international standardization. These steps, the report said, must take precedence over our consideration of the metric problem; they must be taken no matter what action we take on metrication.

"Yet we cannot afford to ignore our need to 'go metric.' Metrication is serious business. If we want to do business with European countries, to what extent are we obliged to compromise with their customary 'engineering standards?'

"The extent to which we do accept their customary engineering standards, the extent that they accept our engineering standards, and the extent to which we reach acceptable compromises on engineering standards will have great effect on our response to the metric problem and upon the world trade patterns for a long time.

"In this connection, it is equally important that we examine the non-participation of the United States in the International Organization for Legal Metrology. It is understandable that the federal government has not given the same attention to national regulations governing type-approval and certification that European countries have.

"We are dedicated to two principles: state responsibility of weights and measures regulation and, within that framework, maximum freedom for innovation by private industry. But, so long as the U.S. does not belong to IOLM, we cannot influence the inevitable growth of legal requirements for metric-based measuring equipment in commerce.

"Worse still, bad technology is being adopted in their criteria for accuracy, and design rather than performance criteria are being written into the recommendations.

"The U.S. Department of Commerce, of which the National Bureau of Standards is a part, has supported U.S. affiliation; the Department of State has now joined in recommending affiliation to the Congress. Hopefully, a decision will be made soon.

"But the main immediate impact of the metric legislation, at least for most of us, will be domestic, not international. In writing the Metric Bill, there was a careful provision made for a period of time [during] which all affected parties would be brought together to plan the conversion timetable, and for approving the plan by the President before conversion begins. Then a decade is allowed for the transition.

"In our Metric Study, we were careful to reject the possibility that an instantaneous, mandatory conversion was contemplated. We do not believe that instantaneous, mandatory conversion is a policy alternative that even requires serious study. Nothing would justify the cost or confusion that such a crash program would entail.

"Instead, if the U.S. decides to 'go metric' it should be done through a coordinated national program based on governmental leadership and voluntary cooperation of all sectors of the society.

"During our Metric Study we found surprisingly strong industry support for metric conversion, especially on a voluntary basis. From a survey of nearly 4,000 firms, chosen to represent some 300,000 U.S. firms that manufacture products, sentiment for or against going metric varied greatly even within the same kinds of industry.

"Large firms tended to be more in favor than small ones, although some small businessmen were among the most outspoken advocates of a metric changeover. Some 70 percent of those manufacturers surveyed voted that increasing the use of metric system would be in the best interests of the U.S.

"More than 90 percent of those who responded preferred a coordinated national program, based on either voluntary participation or mandatory legislation. Only 7 percent favored no national program for going metric.

"It must be clear by now that what is desirable and necessary is a program of *voluntary* conversion, in which each segment would proceed at its own pace to plan and carry out the plan to bring about metrication. I cannot overemphasize the role of private sector standards groups like the Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI) in this voluntary conversion process.

"Industry and government alike must increase our support to these two private bodies as we participate in the international standards-making procedure to ensure that American technology has an equal chance for international recognition.

"Industry, working with government, working with private sector voluntary standards organizations, can take the lead in effective participation in international standardization. Incompatibilities between U.S. practices and those of nations to whom we wish to export can be significant nontariff barriers to trade. Elimination of these technological barriers is one of the most important benefits to be sought in going metric.

"The future well-being of the United States lies in a world of freedom, peace, trade, and individual enterprise in which Americans work together to remove obstacles to our full and proper role in the world's commercial and social affairs.

"No one has better articulated this than President Nixon who, in his inaugural address, said: 'We seek an open world—open to ideas, open to exchange of goods and people, a world in which no people great or small will live in angry isolation.' "

Engineers to Give 'Tickets' to Polluters

With newly granted Congressional authority, the U.S. Army Corps of Engineers will begin giving "tickets" for environmental pollution to persons violating the rules set in Title 36 of the Code of Federal Regulations while using recreational facilities operated by the Corps.

This enforcement authority extends to violations of controls on boating, camping and hunting as well as pollution. The rules prohibit dumping of trash in and around lakes; regulate use of private and commercial boats; prescribe type of mooring; specify care and sanitation for boats and floating facilities; outline regulations for swimming, bathing, hunting, and fishing; and set basic guides for camping and picnicking.

While Corps personnel enforcing the rules will not carry weapons or take offenders into custody, they will have citation authority. Issuing these "tickets" will be a matter coordinated with Federal magistrates and local law enforcement agencies.

The Corps is responsible for management of most of the recreation areas of its more than 390 Corps-built lakes, and the intervening lands as well as the water surface. Corps recreational facilities include 4,500 boat launch ramps, 2,600 picnic areas, 650 swimming beaches, 42,000 tent and trailer spaces, 19,000 rental boats, 300 organized camps, and 4,000 guest and rental units.

Corps personnel enforcing the new authority will wear ranger uniforms with badges and operate from U.S. Government vehicles equipped with appropriate law enforcement identification equipment.

Pollution Control: Improving TNT Processing

Research chemists in the decontamination research section of Edgewood Arsenal's Chemical Laboratory are developing new measures for protecting the nation's waterways.

Headed by Dr. David Rosenblatt, the section conducts research on the chemical reactions and physical properties of toxic chemical agents. This includes defining "chemical personalities" of agents dissolved in water.

The section's experience in water treatment and its special capability in organic chemical research reportedly have proved invaluable in studies on water pollution associated with the manufacture of trinitrotoluene (TNT). The studies were conducted in support of Picatinny Arsenal, Dover, N.J.

"As manufactured," Dr. Rosenblatt said, "the TNT contains nearly five percent of isomeric impurities. These impurities must be removed to meet exacting military specifications."

He pointed out that purification is achieved by the "sellite" process which consists of washing crude TNT with a solution of sodium sulfite. This produces a colored aqueous waste known as "red water" which has a certain degree of toxicity and an intense red color even when diluted.

Currently, such solutions are concentrated and the solid wastes are either sold to pulp mills or incinerated.

Dr. Rosenblatt explained that "although this is an improvement over previous practices, this means of disposal is costly."

The Army has three government-owned, company-operated ammunition plants producing TNT. They are in Radford, Va., Joliet, Ill., and Chatanooga, Tenn. A fourth plant is under construction in Newport, Ind.

Other research chemists associated with the arsenal's research efforts to combat water pollution include Dr. Emory W. Sarver, Dr. George T. Davis, William H. Dennis, George E. Lauterbach and Miss Mary M. Demek.

CHEMICAL ANALYSIS—Dr. George T. Davis, a research chemist at Edgewood (Md.) Arsenal, used a spectrophotometer to analyze the concentration of trinitrotoluene (TNT) in water, while conducting antipollution research.

POLLUTION ABATEMENT—Research chemist William H. Dennis checks rate of water flowing through a column of carbon particles while conducting antipollution research at Edgewood Arsenal, Md.

POLLUTION CONTROL—Dr. David H. Rosenblatt, chief of the Decontamination Research Section of the Edgewood (Md.) Arsenal Chemical Laboratory, prepares a quantity of distilled water used in pollution control research.

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